AL/OE-CR-1994-0015

ARMSTRONG LABORATORY

COMPREHENSIVE COLIFORM CONTAMINATION REPORT
BACTERIOLOGICAL CONTAMINATION PROJECT
ANDREWS AFB, MD

W. Goodfellow
G. Griffin
D. Klingler
C. Riley

EA Engineering, Science, and Technology
11019 McCormick Road
Hunt Valley, MD 21031

OCCUPATIONAL AND ENVIRONMENTAL HEALTH DIRECTORATE
2402 E. Drive
Brooks Air Force Base, TX 78235-5114

September 1994

Final Contractor Report for Period October 1993 – January 1994

Approved for public release; distribution is unlimited.

AIR FORCE MATERIEL COMMAND
BROOKS AIR FORCE BASE, TEXAS

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1994	Final – October 1993 – January 1994

4. TITLE AND SUBTITLE
Comprehensive Coliform Contamination Report
Bacteriological Contamination Project
Andrews AFB, MD

5. FUNDING NUMBERS
C – FY7624-93-00432

6. AUTHOR(S)
W. Goodfellow
G. Griffin
D. Klingler
C. Riley

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
EA Engineering, Science, and Technology
11019 McCormick Road
Hunt Valley, MD 21031

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)
Armstrong Laboratory (AFMC)
Occupational and Environmental Health Directorate
2402 E. Drive
Brooks Air Force Base, TX 78235-5114

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
AL/OE-CR-1994-0015

11. SUPPLEMENTARY NOTES

Armstrong Laboratory Technical Monitor: Lieutenant Colonel John G. Garland III, (210) 536-3305
This report supersedes the Revised Draft Report dated March 1994.

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

This report addresses the investigation of reported reoccurring coliform problems in the potable water system at Andrews Air Force Base (AFB). The base has experienced coliform levels reported above the allowable Maryland standards, that have occurred sporadically over the last 2 years. Data contained in the Andrews AFB water quality records review indicate no distinguishable pattern to the reported coliform contamination by location or time. Further investigation including side-by-side sampling and analysis by Andrews AFB and two independent laboratories indicated the base's handling and collection procedures were the most likely cause for the instances of positive coliform. Sampling results obtained over the 2-month period subsequent to Andrews AFB implementing corrections to these procedures have indicated no coliform contamination.

14. SUBJECT TERMS

Andrews AFB	Coliform
Chlorine	Drinking water

15. NUMBER OF PAGES
188

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

NOTICES

This technical report is published as received and has not been edited by the technical editing staff of the Armstrong Laboratory.

Publication of this report does not constitute approval or disapproval of the ideas or findings. It is published in the interest of STINFO exchange.

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility or any obligation whatsoever. The fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise in any manner construed, as licensing the holder, or any other person or corporation; or as conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

The mention of trade names or commercial products in this publication is for illustration purposes and does not constitute endorsement or recommendation for use by the United States Air Force.

The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

Government agencies and their contractors registered with Defense Technical Information Center (DTIC) should direct requests for copies to DTIC, Building #5, Cameron Station, 5010 Duke St., Alexandria VA 22304-2103.

Non-Government agencies may purchase copies of this report from: National Technical Information Services (NTIS), 5285 Port Royal Road, Springfield VA 22161-2103.

John G. Garland III

JOHN G. GARLAND III, LtCol, USAF, BSC
Contract Project Officer

J. D. Montgomery

JAMES D. MONTGOMERY, LtCol,USAF, BSC,
Chief, Bioenvironmental Engineering
Division

Accesion For	
NTIS CRA&I	X
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and / or Special
A-1	

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. SUMMARY

This report has been prepared in response to a reoccurring coliform problem at Andrews Air Force Base (AFB). The base has observed coliform levels above the allowable Maryland standards sporadically over the last 2 years. However, it is important to note that fecal coliforms were never observed. At the request of Andrews AFB, EA Engineering, Science, and Technology has investigated the potential cause(s) of the observed contamination and recommends corrective actions. The work has been conducted under U.S. Air Force Contract F33615-89-D-4002, Delivery Order 95. This investigation included sampling of Andrews AFB drinking water, reviewing the existing documentation regarding the water distribution system, contacting local water suppliers, and assessing sampling and analytical protocols and practices.

The work has been conducted in a phased approach. In the first phase, EA reviewed existing documentation, analytical data, and operational procedures. Subsequently, EA conducted a sampling program directed at evaluating the various steps in the sampling, handling, and analytical process. Based on the information gathered in the first two phases, EA prepared recommendations to correct the coliform problem. Because of the high visibility of the observed coliform problem, including local media attention, many of the subtasks were conducted simultaneously. An Immediate Action Report was issued by EA in November 1993; this document presented an interim assessment with limited recommendations. This report supersedes that document.

1.1 SITE DESCRIPTION

Andrews AFB is located in Prince George's County, Maryland, and is approximately 5 mi southeast of Washington, D.C. The base encompasses approximately 4,500 acres of land and maintains residential, commercial, and industrial activities. There are approximately 2,300 on-base residences. In addition, the Malcom Grow Hospital and Air Force One Hangar are onsite. The residential population of the site is estimated to be 7,000 and the peak daily population is estimated to be 25,000. It is estimated that there are more than 250,000 linear feet of pipe on base ranging in size from 2 to 16 in. This system includes piping that was installed from the early 1940s to the early 1990s. Water may be supplied by either the Washington Suburban Sanitary Commission (WSSC) or the U.S. Army Corps of Engineers, Washington Aqueduct Division (WAD). Figure 2-1 presents an overview of the Andrews AFB water distribution system. This figure shows map features, including the main distribution loop, supply connections, elevated tanks, and reservoirs.

1.2 FINDINGS

Andrews AFB water quality data records indicated no distinguishable pattern to the observed coliform contamination problem and were inconclusive as to the possible source. Further investigation involving side-by-side sampling and analysis by Andrews AFB and EA (utilizing two independent laboratories) indicated discrepancies in the results. These inconsistencies led to the hypothesis that a problem existed in the base's sampling and/or analytical techniques. Further assessment indicated that the Andrews AFB collection and handling procedures resulted in high levels of positive coliform. Corrections to these procedures, involving rigorously performing field and laboratory methods in accordance with the previously-established protocol, were made prior to submission of this draft document. Subsequent to implementing those changes, the base has not experienced any positive coliform results. This conclusion will be further verified should the base continue to receive negative results from their coliform sampling program. If, however, positive coliform levels are experienced in the future, this report presents guidance to further assess the problem. No problems were observed in the base's analytical technique.

1.3 RECOMMENDATIONS

EA concluded that the cause of the observed coliform contamination of drinking water was the result of the sampling and handling practices employed by Andrews AFB. The study was conducted during winter, and thus the conclusion is tempered by the fact that some seasonal factors could not be accounted for. Seasonal factors such as water temperature may have some impact on coliform bacteria; however, based on EA's review of historical data across the winter and summer of 1993, EA does not believe they are a concern in this situation. The number of positive coliform samples should drop dramatically to a level that is normally zero, after Andrews AFB adopts a more rigorous sample collection and handling procedure. These changes are explained in Section 3.1, and include thoroughly cleaning all equipment involved in the sampling process.

Although both water sources appear to be generally good, EA recommends that Andrews AFB continue using WSSC as the primary water supplier. WSSC has consistently supplied quality water, while WAD has experienced problems with coliform bacteria in the past as shown in their 1992 water quality report (Appendix B, "Water Quality Records"). In particular, the Dalecarlia Water Treatment Plant averaged 1.5 Most Probable Number Index (MPN)/100 ml total coliforms and had a maximum of 5.3 MPN/100 ml total coliforms during the month of June. WSSC's water quality report for 1992 indicated that the percent

of samples testing total coliform positive for 1992 was 0.41 percent, well below the Maryland Department of the Environment standard maximum contaminant level of 5 percent. EA has no reason to believe that there will be a significant change in water quality from either water purveyor. Furthermore, to ensure against future problems, it is recommended that Andrews AFB implement a systematic program of flushing dead-end lines to maintain substantial chlorine residuals throughout the system. This recommendation is explained in detail in Section 3.4.

1.4 COSTS

The costs involved in implementing a more rigorous sampling procedure are expected to be insignificant because this is merely a procedural change. There are no capital costs associated with the flushing program and only minimal maintenance costs.

Finally, provision for adequate water supply to the year 2000 (as outlined in the 1990 Greenhorn & O'Mara report) will involve the addition of a connection near the west gate to supplement the existing 24-in. connection at Allentown Road.

2. WATER SYSTEM EVALUATION

In this section, the history of coliform problems at Andrews AFB is presented, and results from past sampling events are evaluated; subsequently, the results of EA's evaluation of water system practices at Andrews AFB are discussed. Appendix A provides an inventory of relevant documentation and is referenced throughout this section for additional support.

2.1 HISTORY

Andrews AFB has observed coliform contamination within its water distribution system. This contamination was first encountered in August 1991, when bacteriological samples from a number of sample locations throughout the distribution system tested positive. At that time, the base water supply was provided by WAD from the Dalecarlia Water Treatment Plant (DWTP). DWTP was discovered to be a sporadic source of coliform contamination, reporting coliform levels in the plant finished water in June and August 1990 (Appendix A, Section 3.0) and in 1992 (Appendix B). By visual inspection, it was determined that the base reservoir was leaking and was in need of immediate repair. Andrews AFB concluded that the reservoir was the source of contamination (Appendix A, Section 2.0). The reservoir was drained, cleaned, and repaired by grouting the cracks and joints. At that time, Andrews AFB installed a chlorinator at the inlet of the reservoir for the purpose of elevating residual chlorine feed levels in the water system to 3.5 mg/L.

The chlorine feed levels were maintained at 3.5 mg/L, with no recurrence of coliform contamination for a period of 6 months. Andrews AFB recommended maintaining the chlorine concentration at this high level due to the strong risk of possible contamination resulting from the age and design of the water system which had numerous dead ends. In an attempt to resolve the chlorine imbalance problem, Malcolm Grow Medical Center staff suggested installing chlorine boosters on the east side of the base (Appendix A, Section 2.0).

Andrews AFB requested a pre-survey (Appendix A, Section 3.0) on the base drinking water system. The main conclusions of the survey are summarized as follows:

- There is evidence that the DWTP may have been the source for the coliform contamination that occurred in 1991. Monitoring the influent was recommended to determine if the plant was a significant source of contamination.

- There was no correlation between the presence of chlorine residual and negative bacteriological results. Consequently, it was recommended to reduce chlorine levels to below 1.0 mg/L.

- The sampling program should be redefined to include more representative sites (homes on dead-end loops).

- A semiannual flushing program should be reimplemented to include the entire base.

- Chlorine boosters should not be constructed because they may solubilize Safe Drinking Water Act (SDWA) metals due to lower pH.

- Connecting dead-end loops should be considered.

By March 1992, Andrews AFB reduced chlorine residual levels to 1 mg/L on the west side of the base. Andrews AFB concluded that risks from the concrete reservoir were addressed satisfactorily with the addition of the chlorine booster, and that future risks from dead-end lines building up with sediment-harboring bacteria under low chlorine residual were considered significant. Andrews AFB suggested the following countermeasures (Appendix A, Section 2.0):

- Reinstitute a semiannual flushing program to reduce particulates and increase dead-end flows.

- Continue monitoring for bacteria and chlorine at dead-ends and interior loops.

- Connect dead-end loops in residential areas back to the main distribution system.

In March 1993, coliform contamination was found at random locations throughout the base, while no samples tested positive for fecal coliform. Andrews AFB believed the cause of the contamination to be either dirt infiltration into the reservoir or a biofilm throughout the system. Public notices were issued to base consumers and corrective actions were evaluated (Appendix A, Section 4.0). On 22 June 1993, the reservoir was disconnected and the water supply switched from WAD to WSSC. After this conversion, no positive samples were

observed for 3 weeks. However, coliform bacteria were detected in samples taken on 15, 20, and 23 July 1993. This suggested that the source of contamination was biofilm. Andrews AFB recommended consultation with specific technical experts to resolve the biofilm problem (Appendix A, Section 4.0).

EA was retained to address the coliform contamination problems, and commenced work by reviewing previous relevant reports. These reports are listed as follows:

- *Existing Water System Study, Andrews AFB,* May 1987, by Boyle Engineering Corporation.

  This report was used as a reference to evaluate the layout and condition of the existing base water supply and distribution system.

- *Additional Water Source Study for Andrews AFB,* June 1990, by Greenhorne and O'Mara, Inc.

  This report was used as a reference to evaluate the layout and condition of the existing base water supply and distribution system.

- Talking paper on update on bacterial contamination of base drinking water, 27 July 1993, by Major L.A. McGowan.

  This paper was used as a source for background and current status of the coliform contamination at Andrews AFB.

- Memorandum to Malcolm Grow U.S. Air Force (USAF) Medical Center/SGPB for AL/OEB; Brooks AFB, Texas 78235-5000, undated, by Col. E.F. Maher.

  This memorandum was used to survey historic biological data.

2.2 REVIEW OF PRE-EXISTING DATA

EA reviewed the Andrews AFB Bioenvironmental Engineering Sampling Log containing results for the period through August 1993 from sampling of water at various points across the base.

The purpose of this evaluation was to determine if any correlations could be developed between coliform or residual chlorine levels, either by location or season.

Appendix B of this report presents results of coliform and chlorine sampling conducted by Andrews AFB from 13 January to 25 August 1993. Sampling results are presented for 64 points located on Andrews AFB. Identification numbers were assigned by EA for clarity of evaluation; Andrews AFB identifies sampling points by building location. The points and their corresponding identification numbers are presented in Table 2-1 and graphically located in Figure 2-1. Most sampling points are located in Figure 2-1; however, some points sampled less than 10 times have been omitted. EA was unable to locate these points on the Water Supply System drawings provided by Andrews AFB (Appendix E). The omitted points are included in Appendix B to provide complete documentation of the sampling results.

The results presented in Andrews AFB Bioenvironmental Engineering Sampling Log are represented in Appendix B according to the following legend:

- (+) indicates a positive coliform result
- (-) indicates a negative coliform result
- (*) indicates a positive coliform result also testing positive for chlorine in excess of 0.2 mg/L

A value of 0.2 mg/L was selected as representing the minimum acceptable chlorine level to be consistent with IAW AFR 161-44. This regulation indicates that this value must be held throughout the system if it is determined that the base system represents a risk of contamination due to the condition of, or supply to, the base system.

As indicated in the title of the table, the tables in Appendix B list sampling results chronologically for all 64 points. For clarity, these data are presented in summary form as Tables 1 and 2, indicating results by time and location, respectively.

Table 2-2 presents the percent value of total samples which tested positive for coliform at locations sampled at least 10 times between January 1993 and August 1993; Figure 2-2 presents the data graphically. The value of 10 was selected arbitrarily as a minimum to simplify analysis. In addition, Table 2-2 presents the percent value of positive coliform samples which also tested positive for chlorine.

TABLE 2-1 EA IDENTIFICATION NUMBERS OF COLIFORM AND/OR CHLORINE SAMPLING LOCATIONS ON ANDREWS AFB

Sample Location	EA Sample I.D. Number[(a)]
Bldg. 1889 NCO Club	1
Hangar 2, Bldg. 1794	2
Hangar 2, Water Truck 80	2A
Hangar 2, Water Truck 97	2B
1535 BEE	3
Bldg. 1050 MGMC	4
4636 Poplar Ct.	5
Bldg. 2086-A Havord Ave.	6
5136-A Jerstad Ct.	7
Bldg. 2137	8
Hangar 8, Bldg. 1225	9
Hangar 8, Watering Truck	9A
AF 1	10
4003	11
113th Headquarters	12
Bldg. 3575 BEE Lab	13
3780-5 Louisiana Ave. Hsg.	14
3780-3 Louisiana Ave. Hsg.	14A
3780-6 Louisiana Ave. Hsg.	14B
Bldg. 3763 Dining Hall	15
Bldg. 4782	16
Bldg. 4753	17
Bldg. 4700 Youth Center	18
Bldg. 4079	19

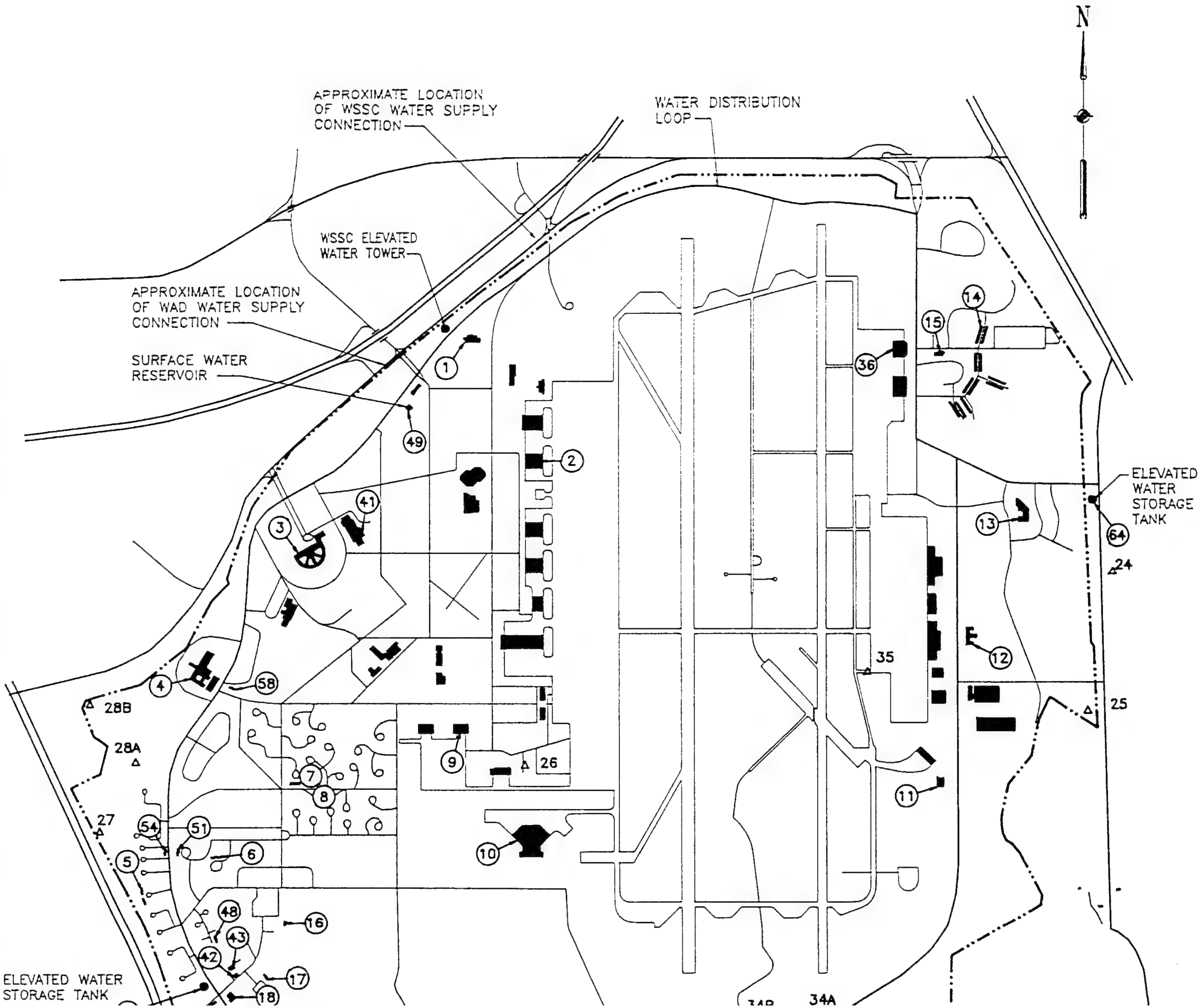
(a) Sample locations 1-23 and 36-64 were tested for coliform and residual chlorine. Sample locations 37-63 were tested for residual chlorine only.

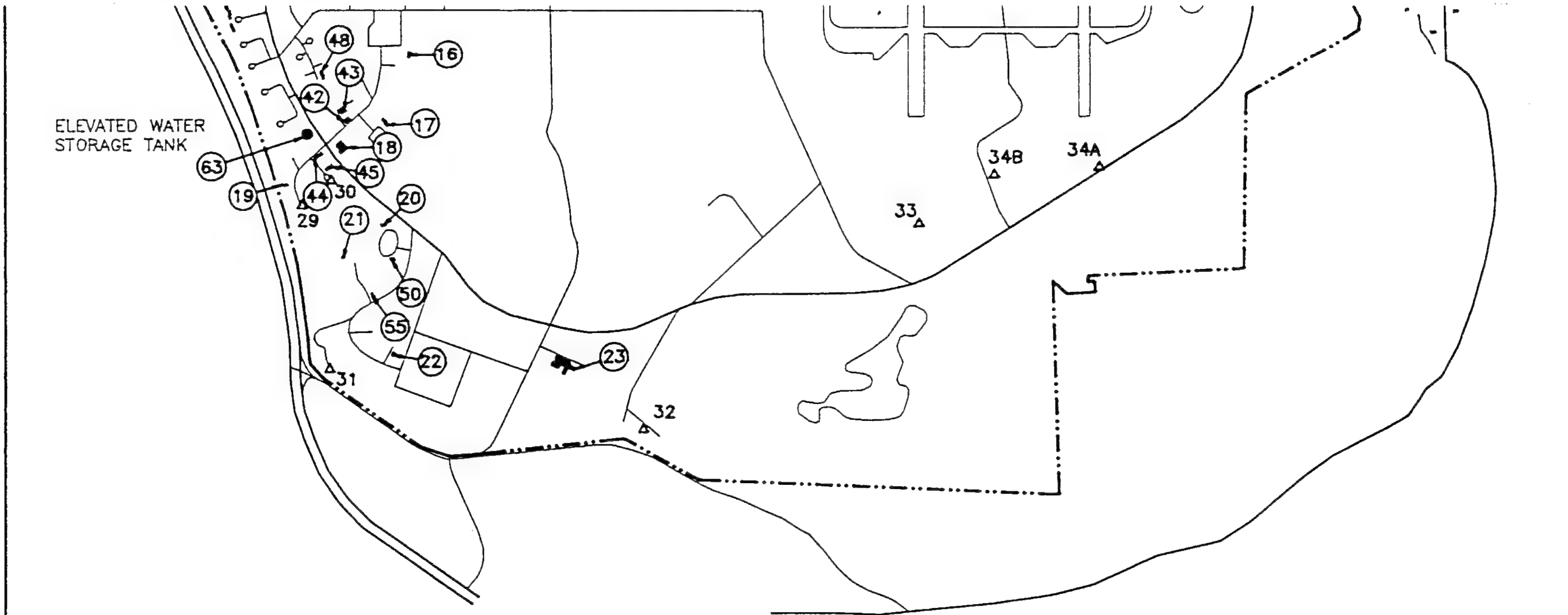
TABLE 2-1 (Cont.)

Sample Location	EA Sample I.D. Number[a]
Bldg. 4027	20
Bldg. 4014	21
Bldg. 4272	22
Bldg. 4575 Child Dev. Center	23
U.S. Army Reserve	24
Joplan\1Boises	25
Bldg. 1289	26
Greenhouse	27
Bldg. 1025	28
Yuma	29
Bldg. 4089	30
Dayton/Cedar	31
Famcamp	32
Bldg. 2326	33
2355 Watertown	34
Flight Deck (Hangar 15)	35
Hangar 10 East Side Sink	36
Watering Truck 47	37
Watering Truck 94	38
#1 Cooling Tower-O Club	39
Alt. Water Point	40
Bldg. 1558 Power Prod.	41
Base Housing Bldg. 4792	42
Inside	42A
Outside	42B
Base Housing Bldg. 4793	43
Base Housing Bldg. 40854	44

TABLE 2-1 (Cont.)

Sample Location	EA Sample I.D. Number[a]
Inside	44A
Outside	44B
Bldg. 4087	45
Bldg. 4613	46
Bldg. 4744	47
Bldg. 4763	48
Bldg. 1836 Reservoir	49
Outlet	49A
Inlet	49B
Bldg. 4022	50
Bldg. 2021	51
Bldg. 3786	52
315 Topeka	53
Bldg. 4671	54
Bldg. 4006	55
Pres. Maint. East Side	56
Pres. Maint. West Side	57
Bldg. 1306 Vanderberg	58
Water Kit #1	59
Water Kit #2	60
Navy Chow Hall	61
WSSC Vault West Pipe	62
Bldg. 4614 West Tower (elevated storage tank)	63
East Tower (elevated storage tank)	64


N
APPROXIMATE LOCATION OF WSSC WATER SUPPLY CONNECTION
WATER DISTRIBUTION LOOP
WSSC ELEVATED WATER TOWER
APPROXIMATE LOCATION OF WAD WATER SUPPLY CONNECTION
SURFACE WATER RESERVOIR
ELEVATED WATER STORAGE TANK
ELEVATED WATER STORAGE TANK
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
24
25
26
27
28A
28B
34A
35
36
41
42
43
48
49
51
54
58
64



LEGEND:

(23) SAMPLE LOCATION FOR COLIFORM AND RESIDUAL CHLORINE. REFER TO TABLE 2-1 FOR DETAILS.

△ SAMPLE LOCATION FOR RESIDUAL CHLORINE. REFER TO TABLE 2-1 FOR DETAILS.

SOURCE:

ANDREWS A.F.B. WATER SUPPLY SYSTEM, MASTER PLAN (APPENDIX E).

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.	ANDREWS AIR FORCE BASE CAMP SPRINGS, MARYLAND	FIGURE 2-1 COLIFORM AND CHLORINE SAMPLING LOCATION PLAN

PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE	PROJECT NO.	FILE NAME	DRAWING NO.	SHEET NO.
CJR	–	FDM	CDG	3-22-94	1"=2000'	11206.95	SITE1	–	1 OF 1

TABLE 2-2 ANDREWS AFB TOTAL COLIFORM AND CHLORINE TEST RESULTS BY LOCATION, 13 JANUARY TO 25 AUGUST 1993[a]

Sample Location	Sample I.D.[b]	Sampling Events[c]	Positive Coliform	Percent Positive Coliform	Positive Chlorine[d]	Percent Positive Chlorine[e]
Hangar 2, Bldg. 1794	2	48	8	17	7	88
1535 BEE Lab[f]	3	34	2	6	2	100
Bldg. 1050 MGMC	4	52	8	15	7	88
5136-A Jerstad Ct.	7	43	5	12	4	80
Hangar 8, Bldg. 1225	9	45	10	22	9	90
113th Headquarters	12	52	9	17	1	11
Bldg. 3575 BEE Lab[g]	13	10	0	0	0	0
3780-5 Louisiana Ave. Hsg.	14	30	9	30	8	89
Bldg. 3763 Dining Hall	15	46	4	9	3	75
Bldg. 4700 Youth Center	18	55	3	5	2	67
Bldg. 4575 Child Dev. Center	23	48	4	8	0	0
Building 1836 Outlet	49A	24	4	17	4	100
Building 1836 Inlet	49B	25	8	32	8	100

(a) Samples/Analyses conducted by Andrews AFB (Referenced Appendix C).
(b) Refer to Figure 2-1 for sample location.
(c) Only locations sampled at least 10 times are recorded.
(d) Number of coliform-positive results which tested chlorine-positive (>0.2 mg/L).
(e) Percent of coliform-positive results which tested chlorine-positive (>0.2 mg/L).
(f) Present BEE Lab location (since April 1993). Samples collected from 13 April to 25 August 1993.
(g) Former BEE Lab location (prior to April 1993). Samples collected from 13 January to 8 April 1993.

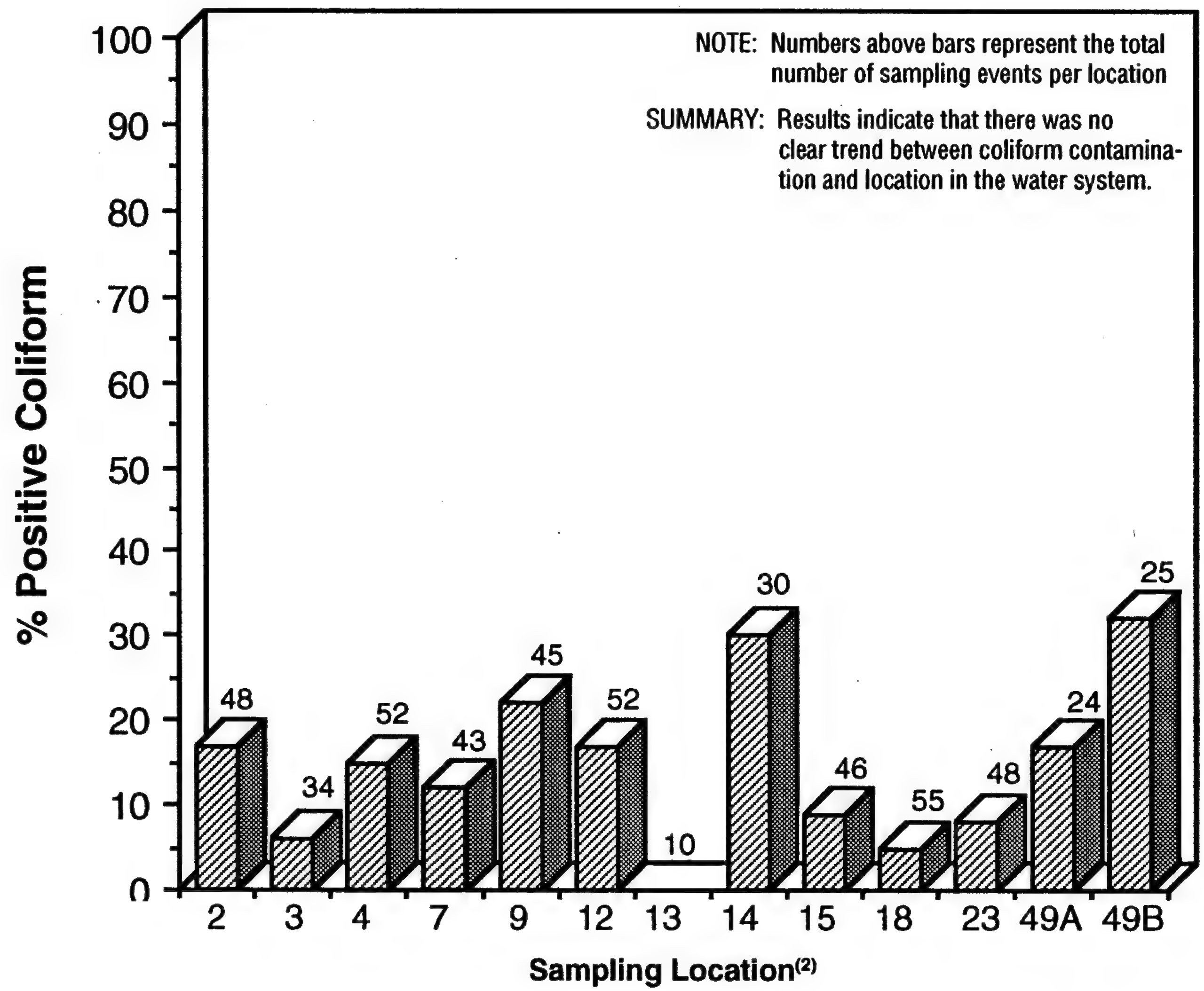


Figure 2-2. Andrews AFB % positive coliform results by location(1).

(1) Sampling Period 1/13/93 to 8/25/93 conducted by Andrews AFB (Reference APP. B).
(2) Refer to Table 2-3 for location. Only locations samples at least 10 times are recorded.
No dead-end locations were sampled 10 or more times for coliform during this sampling period; therefore, no dead-end locations are represented on this figure.

The results presented in Table 2-2 and Figure 2-2 indicate that there is no clear trend between coliform contamination and location in the water system. In addition, it appears that no relationship exists between low residual chlorine and coliform contamination in the water system. This supports conclusions drawn by Col. Edward F. Maher of Brooks AFB (Appendix A, Section 3, Pre-Survey on Base Drinking Water). Further review of these data indicates that the three locations (points 9, 14, and 49B) representing the highest percentage positive coliform were not located at dead-ends.

Table 2-3 and Figure 2-3 present the percent value of total samples that tested positive for coliform on various days from January to April 1993, in which at least 10 sampling events occurred; the average percent positive coliform is 20 percent. This compares to Table 2-4 and Figure 2-4, which present the percent value of total samples that tested positive for coliform on various days from March to August 1993, in which at least 10 sampling events occurred; the average percent coliform is 14 percent. These results indicate that there was no seasonal variation in coliform contamination in the water system during the period January through August 1993. This supports the ability to apply results drawn from EA's study (conducted during winter) throughout the year.

2.3 DOCUMENT REVIEW

This section addresses the results of EA's review of available documentation on the Andrews AFB water supply system.

2.3.1 Civil Engineering Records and Maps

Water supply system plans and cross-connection inventory and maintenance records were provided by civil engineering personnel. EA reviewed these, with particular reference to cross-connections. Appendix A, Section 6, is an inventory of cross-connections conducted in August 1989. COMAR 26.04.21.32 requires that a cross-connection control plan be submitted to the Maryland Department of the Environment (MDE) for approval. The plan was submitted on 12 March 1991 and approved by MDE on 26 March 1991 (Appendix A, Section 6).

2.3.2 Water Storage Tanks and Reservoir

2.3.2.1 Elevated Water Storage Tanks

According to base bioenvironmental personnel, the repairs outlined in the Boyle Engineering report of May 1987 involving extensive cleaning, painting, and structural repairs have been completed, and the tanks are in excellent condition. EA could not witness the use of these tanks because they are not compatible with the pressure associated with the WSSC supply and are valved off.

2.3.2.2 Fire Suppression Tanks

These ground-level tanks are hydraulically isolated from the potable water system by backflow devices. The connections to these tanks must be checked as part of the regular cross-connection maintenance program.

2.3.2.3 In-Ground Reservoir

Previous studies have identified this reservoir as a potential source of coliform contamination. This reservoir, originally constructed in 1942, was drained and inspected in 1991. According to base personnel, large cracks were found in the reservoir. The cracks have been partially repaired and were believed to be contributing to the coliform contamination due to the potential of direct contact with soil. However, the reservoir is currently not being used and cannot be directly attributed with any coliform contamination events.

2.3.3 Appendix B, Water Quality Records

Water quality records are kept of coliform, pH, and fluoride testing completed by the base. The base is required to sample at least nine sites every month in accordance with COMAR 26.04.01. Review of these data indicates that current reporting practices are in accordance with COMAR. EA used these data for the period January-August 1993 to evaluate recorded coliform and residual chlorine levels (as discussed earlier in this section).

TABLE 2-3 ANDREWS AFB TOTAL COLIFORM TEST RESULTS BY DATE, 13 JANUARY TO 27 APRIL 1993[a]

Date of Sampling	Sampling Events[b]	Positive Coliform	Percent Positive Coliform	Positive Chlorine[c]	Percent Positive Chlorine[d]
03/06/93	11	6	55	5	83
03/07/93	23	6	26	5	83
03/09/93	10	0	0		
03/17/93	10	2	20	2	100
03/18/93	12	4	33	4	100
03/30/93	10	3	30	3	100
04/08/93	11	0	0		
04/13/93	13	0	0		
04/20/93	11	1	9	1	100
04/27/93	24	8	33	7	88
Average	14	3	20	4	93

(a) Samples/Analysis conducted by Andrews AFB (reference Appendix C).
(b) Only dates on which at least 10 samples were collected are recorded.
(c) Number of coliform-positive results which tested chlorine-positive (>0.2 mg/L).
(d) Percent of coliform-positive results which tested chlorine-positive (>0.2 mg/L).

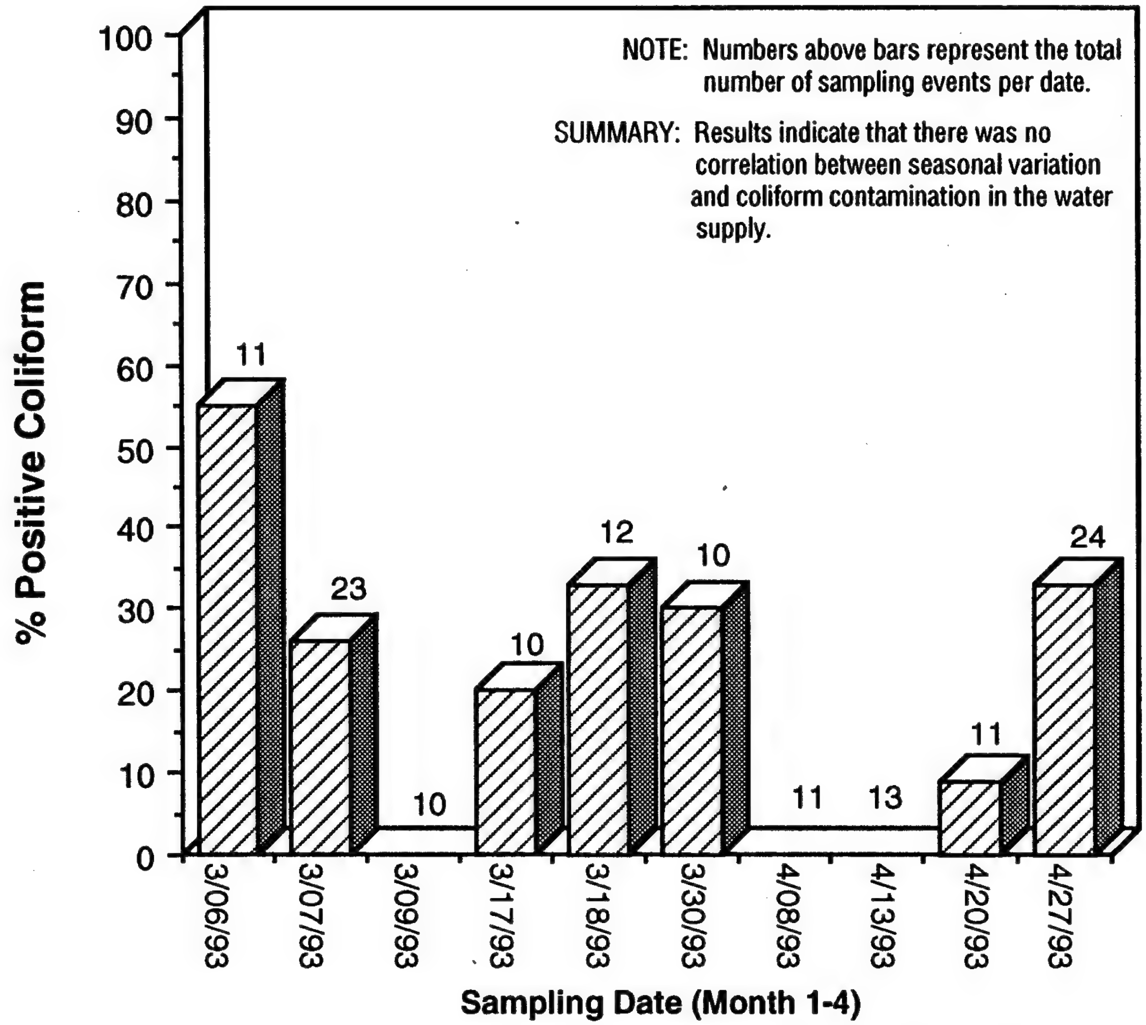


Figure 2-3. Andrews AFB % positive coliform results by date[1].

(1) Sampling Period 1/13/93 to 8/25/93 conducted by Andrews AFB (Reference APP. B).

TABLE 2-4 ANDREWS AFB TOTAL COLIFORM TEST RESULTS BY DATE, 5 MAY TO 25 AUGUST 1993[a]

Date of Sampling	Sampling Events[b]	Positive Coliform	Percent Positive Coliform	Positive Chlorine[c]	Percent Positive Chlorine[d]
05/12/93	20	0	0		
05/19/93	22	4	18	2	50
05/26/93	20	4	20	2	50
06/02/93	24	4	17	2	50
06/09/93	24	1	4	0	0
06/16/93	10	0	0		
06/17/93	13	1	8	0	0
06/24/93	26	3	12	2	67
06/30/93	20	5	25	4	80
07/07/93	20	1	5	1	100
07/14/93	22	0	0		
07/15/93	20	12	60	5	42
07/20/93	20	9	45	6	67
07/23/93	20	3	14	1	33
07/29/93	22	0	0		
08/04/93	18	1	6	1	100
08/11/93	16	0	0		
08/18/93	24	1	4	1	100
08/25/93	20	6	30	4	67
Total	383	55			
Average	20	3	14	2	58

(a) Samples conducted by Andrews AFB (reference Appendix C).
(b) Only dates on which at least 10 samples were collected are recorded.
(c) Number of coliform-positive results which tested chlorine-positive (>0.2 mg/L).
(d) Percent of coliform-positive results which tested chlorine-positive (>0.2 mg/L).

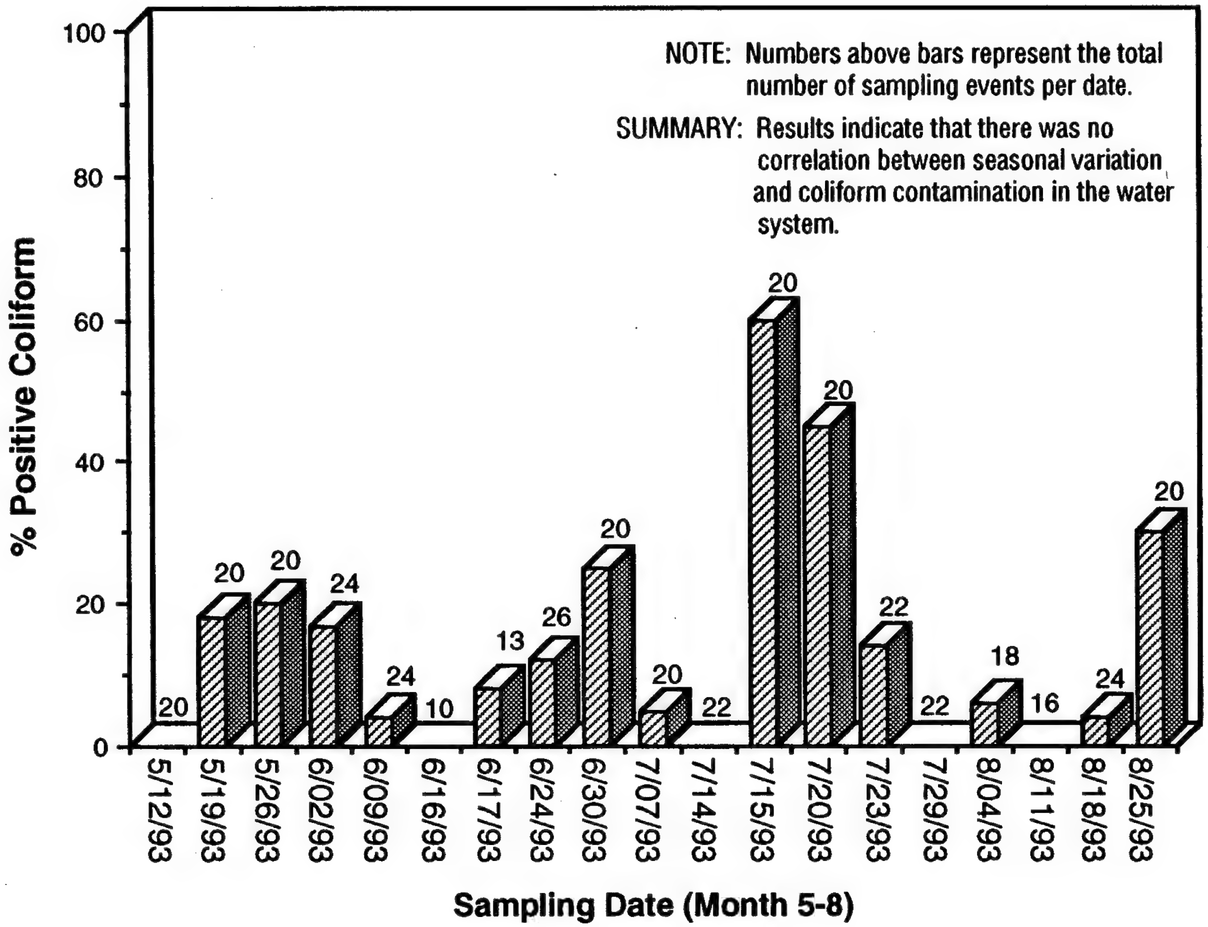


Figure 2-4. Andrews AFB % positive coliform results by date[1].

(1) Sampling Period 1/13/93 to 8/25/93 conducted by Andrews AFB (Reference APP. B).

2.3.4 Flushing Records

Andrews AFB does not conduct a systematic flushing program. As confirmation, EA requested flushing records but has not received any documentation.

2.3.5 Cross-Connections

2.3.5.1 General

Andrews AFB is required to develop a cross-connection control program (CCCP) to prevent cross-contamination by ensuring that backflow preventers are installed and maintained correctly. The three types of backflow preventers described in AFR 91-26 and used at Andrews AFB are:

- Air gap
- Double check valve assembly
- Reduced pressure principle backflow preventer (RPBP)

The air gap backflow preventer involves a spacing of air between potable and non-potable distribution systems, and represents the most effective method to prevent cross-contamination. The double-check valve assembly consists of two check valves placed in series along the line between a potable and non-potable source, such that cross-contamination may occur only if both check valves fail. The RPBP is a double check valve system with a pressure relief valve. The RPBP device has an additional advantage over the double check valve in that the pressure relief valve will ensure that inlet pressure is always greater than outlet pressure. Thus, even if both check valves of the RPBP fail, the potable line pressure will always be greater than the non-potable line pressure because of the pressure relief valve. Cross-contamination can only occur if both RPBP check valves fail and the pressure relief valve fails while backflow potential exists.

Approved backflow devices must be installed based on the degree of hazard. These hazards are divided into three classes, which are summarized from AFR 91-26 and provided below:

- Class I—Low Degree of Hazard. The potential contaminants must be non-toxic or non-bacterial in nature with no significant health effect to be classified as Class I.

- Class II—Moderate Degree of Hazard. If backflow were to occur, the resulting contamination could cause significant changes in aesthetic qualities. The potential contaminant must be non-toxic to humans.

- Class III—High Degree of Hazard. If a backflow were to occur, the resulting contamination could cause illness or death if consumed by humans.

The type of backflow preventer required is based on the degree of hazard, as shown in Table 2-5.

An inventory of Andrews AFB cross-connections control and backflow prevention devices was conducted by base personnel in August 1989. While this inventory was not comprehensive across Andrews AFB, the results indicate that those cross-connections investigated are in compliance with the requirements shown in Table 2-5. However, EA has not confirmed the existence of these devices beyond the information provided in the inventory.

Andrews AFB maintains a CCCP comprising three components involving the Air Force, Navy, and Air National Guard. Each has its own plan, as discussed in the following section. There are no indications that the Navy or Air National Guard plans have been approved. All CCCPs must be in accordance with COMAR 26.04.01.32, the Uniform Plumbing Code (UPC), and the UPC Illustrated Training Manual for operations and maintenance purposes.

2.3.5.2 Air Force CCCP

The Air Force plan was approved by MDE in March 1991. The plan indicates that an inventory of cross-connections must be performed every 5 years utilizing AF Form 848. The current inventory of the cross-connection and backflow preventers was compiled in August 1989. Therefore, the cross-connection inventory must be updated by August 1994.

The current cross-connection survey indicates that the base had at least 28 cross-connections; four have been removed or replaced subsequent to the survey. Appendix B civil engineering personnel stated that these 24 cross-connections listed in the Air Force CCCP are not the only cross-connections currently existing.

TABLE 2-5 APPROVED BACKFLOW DEVICES

Degree of Hazard	Allowed Approved Devices
Class I	Air Gap Atmospheric Type Vacuum Breaker Pressure Type Vacuum Breaker Double Check Valve Assembly Reduced Pressure Principle Device
Class II	Air Gap Double Check Valve Assembly Reduced Pressure Principle Device
Class III	Air Gap Reduced Pressure Principle Device

2.3.5.3 Navy CCCP

Currently, the Navy has one 250,000-gal fire fighting deluge tank, and the existing backflow preventer is an RPBP. At the time of this report, the Navy was in the process of replacing the existing RPBP. EA has requested additional information regarding this program, but did not receive any documentation.

2.3.5.4 Air National Guard CCCP

EA has requested information regarding the Air National Guard program but has not received documentation.

2.3.6 Line Repair and Disinfection

Line repair and disinfection of damaged water distribution piping is performed by base Civil Engineering (CE) and Bioenvironmental Services (BES) personnel in accordance with American Water Works Association (AWWA) Standard 651 (Appendix C). It is the responsibility of CE to notify BES of water piping breaks so that disinfection of the damaged piping is completed in accordance with AWWA standards. However, EA has been informed by base personnel that this communication has not always occurred due to the urgency with which damaged water piping must be repaired and returned to service. Therefore, repaired water lines which were returned to service without disinfection are a possible source of bacterial contamination. There is evidence, however, of improvement in the procedure. For example, the Andrews AFB BES Sampling Log indicates that sampling occurred on 25 March 1993 in response to a broken water line. In this event, BES personnel were notified of the break and were able to ensure proper disinfection of the repaired piping.

2.3.7 Disinfection of New Water

Disinfection of new water distribution piping is completed in accordance with AWWA Standard 651 (Appendix C). Civil Engineering is responsible for implementing these disinfection procedures during construction of new water piping. In addition, BES is required to approve design drawings and disinfection procedures of new water piping before construction begins. BES's involvement during design and construction of new water piping indicates that AWWA standards are enforced.

2.3.8 Leak Detection and Management

Andrews AFB does not have a leak detection and management program for the water distribution system. Hydrostatic pressure and leakage testing should be performed in accordance with AWWA Standard C600-87, Section 4.0, on all new water distribution piping during installation.

2.3.9 Valve Management

Andrews AFB does not have a valve management program for the water distribution system. The system's gate valves should be inspected and maintained in accordance with AWWA Standard C500-86, Section A.6. A valve management program in accordance with this standard includes operating each gate valve through a full cycle and returning it to its normal position on a schedule designed to prevent a buildup of tuberculation or other deposits that would render the valve inoperable or prevent a tight shutoff. While EA did not inventory the valves, it is estimated that a crew of two persons can exercise approximately 20-30 valves in one day.

2.3.10 Fire and Other Water Demand Documentation

An investigation of the Andrews AFB water system was conducted by Boyle Engineering in 1987. This study projected a 17 percent increase in demand over the 1987-2000 planning period and recommended improvements to the on-base water storage and distribution systems. The report also identified a shortfall in water supply to meet the year 2000 maximum day demands. In 1990, Greenhorne and O'Mara (G&O) conducted an evaluation of the various methods of meeting the projected year 2000 average and maximum day demands, and recommended improvements to the existing on-base storage and distribution systems to improve pressure distribution throughout the service area and to provide adequate water storage facilities in accordance with Air Force Manual 88-10. The alternative recommended by G&O is the addition of a connection near the west gate to supplement the existing 24-in. connection at Allentown Road. The capital cost of this alternative is estimated at $123,000.

2.4 PERSONS CONTACTED

EA utilized Air Force personnel as the primary contacts for information. Lt. Col. Garland, located at Brooks AFB, Texas, served as the project manager. Maj. Lawrence A. McGowan

acted as the main point of contact at Andrews AFB. Ms. Michelle Margolis served as the alternate point of contact. Cpt. Thomas Fryer, an officer in the BES laboratory, provided information relating to laboratory operations. Sgt. James Percy and Airman Chadwick Kinser are BES personnel who conducted all phases of the side-by-side sampling and analyses. Mr. John Bossert is the water and waste foreman for the civil engineering department at Andrews AFB and provided information on operating and maintenance practices.

Off-base personnel were contacted to provide additional information, as appropriate. Mr. Tim Hirrel of WSSC and Mr. George Papadopolous of WAD provided laboratory results of their respective water supplies. Mr. Joseph Wolfkill III, president of Martel Laboratories, Inc., assisted in the review of the base's sampling and analysis techniques.

2.5 WATER QUALITY DATA

2.5.1 Historical

The two water sources that have been used by Andrews AFB for drinking water have been from the Washington Aqueduct Division and the Washington Suburban Sanitary Commission. This study did not evaluate the individual analytical drinking water parameters from the water distribution system at Andrews AFB, with the exception of residual chlorine, trihalomethanes (THM), and total coliforms. However, by reviewing the available data for the two major water sources of Andrews AFB, a reasonable level of certainty can be developed as to whether any additional water quality concerns exist as a result of these water sources.

2.5.1.1 WAD Water Quality Data

The most recent comprehensive analytical data (1992) from WAD's two water treatment plants (WTP), Dalecarlia WTP and McMillan WTP, are presented in Appendix B. Review of the data and comparison with Maryland's drinking water standards (COMAR 26.04.01.06 and .07) indicate that, with the exception of total THM at the McMillan WTP, both facilities consistently met the water quality requirements. The water from these two plants can be classified as very hard water, ranging in hardness from 110 to 755 (average 131) mg/L $CaCo_3$ for the Dalecarlia WTP and from 107 to 153 (average 129) mg/L $CaCO_3$ for the McMillan WTP. In addition, total coliform analyses from the two plants ranged from 0.0 to 5.3 (average 1.5) MPN/100 ml and from 0.9 to 3.5 (average 0.8) MPN/100 ml, respectively.

Based on these data, with the exception of THM, WAD is an acceptable drinking water source for Andrews AFB.

2.5.1.2 WSSC Water Quality Data

The 1992 analytical data from WSSC's two filtration plants, Potomac WTP and Patuxent WTP, are also presented in Appendix B. Review of these data and comparison with Maryland's drinking water standards indicated that both facilities consistently met the water quality requirements. Similar to WAD, the two WSSC facilities can also be classified as distributing very hard water ranging in hardness from 113 to 150 (average 130) mg/L $CaCO_3$ for the Potomac WTP and from 96 to 122 (average 111) mg/L $CaCO_3$ for the Patuxent WTP. The total coliforms from these two plants ranged from 0.0 to 1.74 (average 0.4) MPN/100 ml. Based on the analytical data, WSSC is an acceptable drinking water source for Andrews AFB, and it appears to be slightly better than WAD when compared for total trihalomethanes and total coliform concentrations.

2.5.2 Sample Collection

2.5.2.1 Residual Chlorine

Total and free chlorine concentrations were evaluated at select sampling locations within the distribution system. These sampling locations are presented in Figure 2-1 and Table 2-1. Prior to sample collection, the water was allowed to flow approximately 30 seconds following MDE guidance and *Standard Methods* (APHA et al. 1992). This ensures that the water immediately within the piping faucet assembly was purged and that water was collected within the building/residence distribution system. Thus, collection of water for chlorine residual was a conservative estimate of the total and free residual chlorine concentrations. Each sample was collected in 500-ml Nalgene® bottles. The order of sample collection was not predetermined, nor was a record kept of the order of sample collection at each site. One sample container was filled for each of the 23 sample locations. The sample containers were filled without headspace and stored in the dark in order to prevent degradation of the chlorine prior to analysis. Samples were evaluated onsite within 2 hours of collection.

Martel Laboratories conducted field evaluations for total residual chlorine with their evaluation of coliforms. Approximately 50 ml of sample was collected in a glass beaker after the water was allowed to flow for approximately 30 seconds. In addition, Andrews

AFB conducted split sampling and analysis with EA's subcontracted microbiological laboratories. Andrews AFB employed their standard operating procedures of allowing the water to run approximately 30 seconds, filling the collection tube per the manufacturer's standard instructions (e.g., Hach). Testing immediately followed sample collection by both Martel and Andrews AFB.

2.5.2.2 Coliform

Samples for coliform tests were collected by EA personnel. The tap was allowed to flow approximately 3 minutes after the chlorine sample was collected. As for the chlorine sample, no predetermined order was used for the collection of the coliform samples. Three samples per station were collected in pre-sterilized collapsible bags (e.g., Whirl Pacs). All samples were collected according to MDE guidance and according to *Standard Methods* (APHA et al. 1992). Care was given to ensure that the sample containers did not come in contact with the faucet tap. After each sample bag was filled, the containers were labeled and placed in a larger pre-sterilized zip-lock bag. This zip-lock bag was then placed on wet ice for sample shipment. The samples collected on 16 November 1993 were received by Gascoyne Laboratories early the next morning. The samples collected on 17 November were hand carried to and received by Gascoyne Laboratories on the same day as sample collection.

In a side-by-side sampling effort by Andrews AFB personnel, the samples were also collected using the collapsible sampling bags with the standard materials and procedures for sample collection typically used by the base. After each container was filled, the containers were labeled and placed in a rack within a cooler containing "blue-ice" packs on the bottom. The samples collected in the morning were transferred to a small refrigerator in the Andrews AFB laboratory until analysis could be performed. The samples collected in the afternoon were tested the same day, along with the samples collected in the morning. Samples collected starting 15 December 1993 were collected in pre-sterilized bottles, similar to the methods described from Martel Laboratories (below).

Based on the results of the split sampling (Appendix B) and the observation of potential sampling contamination, additional samples were collected and an audit of Andrews AFB water sampling and analytical techniques was performed by another independent laboratory (Martel Laboratories) on 30 November 1994. Unlike the initial split-sampling event, Martel Laboratories collected one water sample from each site in pre-sterilized 500-ml Nalgene® containers while Andrews AFB, for this site-by-site sampling event, collected the sample

using the same procedures and containers as described previously (i.e., collapsible sampling bags).

2.5.3 Analytical Procedures

2.5.3.1 Residual Chlorine

The samples collected by EA were analyzed for free and total residual chlorine using the amperometric titration method (EPA 330.1). Duplicates of each sample were analyzed daily for both free and total combined residual chlorine using temporary laboratory space provided by Andrews AFB. Replicates of a control sample were also evaluated before each analysis period in order to condition the electrode and to ensure that the titration apparatus was functioning properly. Each titration followed the EPA 330.1 (EPA 1979) procedure using 200 ml of sample.

Andrews AFB and Martel Laboratories used the field method for residual chlorine evaluation (EPA 330.5). Andrews employed the Hach Kit procedure by dissolving a reagent in a test tube containing the sample. The sample was then observed for color change as compared to a standard chart corresponding to the respective free chlorine level. Martel Laboratories followed the same residual chlorine procedure; however, color change was evaluated photometrically.

2.5.3.2 Coliform

Samples for coliform analysis were evaluated using the standard procedures established by MDE. The samples collected by Andrews AFB between 16 and 30 November 1993 and on 27 January 1994 were analyzed by the MMO-MUG (colilert) method (EPA 1991). Sample collection between 1 and 20 December 1993 and on 26 January 1994 was performed using the membrane filter method (APHA et al. 1992). In addition, the laboratory also evaluated a negative blank after every five samples, and at the end of each testing day a solution known to contain coliform bacteria was evaluated as a positive control. The samples evaluated side-by-side with Andrews AFB by Gascoyne Laboratories also used the MMO-MUG method. The samples evaluated side-by-side with Andrews AFB by Martel Laboratories used the MMO-MUG method as well as the membrane filter method.

2.5.4 Results of Residual Chlorine and Coliform Analyses

The results of the evaluation of residual chlorine and coliform analyses by Andrews AFB and EA, in association with the two independent laboratories, Gascoyne Laboratories and Martel Laboratories, are presented in Table 2-6.

2.5.4.1 Residual Chlorine

Total combined and free residual chlorine (TRC) was observed at each sample location for the two side-by-side EA/Andrews AFB sampling events regardless of the sampling and analysis method or the day the samples were collected. TRC concentrations ranged from 0.01 to 2.01 mg/L (Table 2-6). The most significant conclusion from these data is that detectable residual chlorine was observed at all sample locations, even the stations where positive coliform results were determined from the analyses by Andrews AFB.

The TRC concentrations appear to be relatively consistent for the sample locations. For example, samples collected from locations with higher TRC levels were similar in concentration during both events, as were locations with lower concentrations. Three notable exceptions were observed at Site 17 (4753 Fairway), Site 18 (Youth Center), and Site 19 (4079). These samples were consistently higher in the 16-17 November 1993 sampling effort when compared to the 30 November sampling period (Table 2-6). Samples collected from Site 12 (113th HQ), Site 13 (3575), Site 16 (4782 Command Drive), and Site 19 (4079) had TRC levels less than 0.06 mg/L. These lower values may not provide the level of "buffer" for detectable TRC levels necessary for consistent disinfection. More rigorous flushing practices (as proposed in Section 3) should ensure consistently higher residual chlorine levels within the distribution system.

In addition, the pH values observed for these two sampling periods ranged from 7.2 to 8.6. With the exception of the 8.6 value observed at Site 12 (113th HQ), these values are consistent with pH values observed in drinking water samples for this region. If Site 12 were considered an outlying data point, the pH range would be 7.2-7.9. These values suggest that potable water within the Andrews AFB distribution would not have a high potential for increased dissolved metals as it would if the pH would be consistently below 6. However, no analytical data were evaluated to completely address the levels of metals in the potable water (i.e., lead) since it was not the objective of this study.

2.5.4.2 Coliform

In the side-by-side sampling effort between Andrews AFB and EA (in association with the two independent laboratories), substantial differences were observed in the results achieved by Andrews AFB and EA. While EA reported one positive test for the two test events, Andrews AFB recorded 14 positive coliform tests. Furthermore, of the 14 positive results recorded by the base, only two samples from the first side-by-side sampling effort were positive in the second side-by-side evaluation period (Table 2-6). In addition, the positive values observed during these two sampling periods were obtained from water samples with detectable levels of residual chlorine ranging from 0.06 to 1.44 mg/L TRC.

Based on the results of the initial side-by-side evaluation by EA's independent laboratory (Gascoyne Laboratories) and Andrews AFB and the observations of EA's field crew, the second sampling effort and an audit of the sample collection/analytical procedures was scheduled to determine whether sampling or analytical bias existed for the samples collected by Andrews AFB. As discussed previously, the results of the second side-by-side sampling effort between Andrews AFB and a second independent laboratory yielded results similar to the first side-by-side sampling/analysis effort. The results of the two efforts strongly suggested that Andrews AFB results were substantially different from the results of the two independent laboratories. In addition, the sample transportation container was observed to be dirty, suggesting that a potential bias of the Andrews AFB collected samples may have existed. These results indicated that an audit of the sampling/analytical methods used by Andrews AFB should be performed prior to the evaluation of additional samples.

One of the independent laboratories subcontracted by EA, Martel Laboratories (Mr. Joe Wolfkill), performed the audit for the sampling and analytical procedures employed by Andrews AFB. Since the base's analytical procedures were recently audited by MDE as part of the MDE certification program, more effort was directed toward auditing the sampling procedures and the report from this audit can be found in Appendix A, Section 5. The results of the audit of the sampling procedures indicated that the use of the collapsible sample bags may have been compromised. The bags were not being stored properly prior to sample collection with the storage of the sample bags in nonsterile conditions. In addition, the sample transportation container (while clean during the audit) was not clean during the side-by-side sampling events based on interviews with Andrews AFB sample collection staff and EA's field crew observations. Direct observations of the potential contamination of the cooler could not be made during the audit. The audit results suggested that the samples were being contaminated when the samples were poured into the testing vessels prior to testing.

TABLE 2-6 ANALYTICAL ANALYSIS OF SELECTED SITES AT ANDREWS AFB INCLUDING SIDE-BY-SIDE EVALUATION OF TOTAL COLIFORM, NOVEMBER 1993 TO 27 JANUARY 1994

Site Location	Sample Description	16-17 November 1993						30 November 1993					
		pH		TRC (mg/L)		Coliform Analysis		pH		TRC (mg/L)		Coliform Analysis	
		AAFB	EA	AAFB	EA	AAFB[(a)]	EA-1[(a)]	AAFB	EA	AAFB	EA	AAFB[(a)]	EA-2[(a)]
1	1889 NCO Club	7.6	7.8	<0.1	2.01	A	A	7.4	7.5	1.2	1.50	A	A
2	Hangar No. 2	7.4	7.7	1.5	1.53	A	A	7.4	7.4	1.0	1.40	A	A
3	1535 BEE	7.5	7.7	1.0	0.96	**P**	A	7.2	7.2	0.5	1.20	A	A
4	MGMC	7.4	7.7	1.5	0.43	A	A	7.4	7.4	0.8	0.80	A	A
5	4638 Poplar Ct.	7.7	7.8	1.0	1.27	A	A	7.4	7.4	0.8	1.10	A	A
6	2086-A	7.5	7.8	1.5	1.44	**P**	A	7.2	7.2	1.0	1.40	A	A
7	5136 Jerstat Ct.	7.6	7.8	0.5	1.39	A	A	7.4	7.4	0.8	1.10	A	A
8	2137	7.6	7.7	1.0	1.05	A	A	7.4	7.4	0.8	1.40	A	A
9	Hangar No. 8	7.6	7.7	1.0	1.51	A	A	7.4	7.4	1.0	1.20	**P**	A
10	AF-1	7.6	7.8	1.5	1.12	A	A	--	--	--	--	--	--
11	4003	7.6	7.8	1.0	0.83	A	**P**	7.4	7.0	0.8	0.75	**P**	A
12	113th HQ	7.8	8.6	<0.1	0.06	**P**	A	7.4	7.0	<0.1	0.03	A	A
13	3575	7.6	7.2	<0.1	0.13	**P**	A	7.4	7.0	<0.1	0.02	A	A
14	3780 Louisiana Avenue	7.5	7.6	1.5	1.39	**P**	A	7.6	7.0	1.0	1.20	A	A
15	Dining Hall	7.5	7.7	1.0	1.43	A	A	--	--	--	--	--	--
16	4782 Command Drive	7.5	7.9	<0.1	0.13	A	A	7.6	7.0	<0.1	0.04	A	A
17	4753 Fairway	7.5	7.8	0.1	0.54	A	A	7.6	7.0	0.1	0.13	A	A
18	Youth Center	7.6	7.7	1.0	0.87	A	A	7.2	7.0	<0.1	0.17	A	A
19	4079	7.5	7.8	1.5	0.75	**P**	A	7.4	7.0	<0.1	0.01	A	A
20	4027	7.5	7.7	<0.1	0.07	**P**	A	7.6	7.0	<0.1	0.15	**P**	A
21	4014 Beech	7.6	7.8	<0.1	0.10	**P**	A	7.2	7.0	<0.1	0.28	**P**	A
22	4272 Wilmington	7.5	7.8	<0.1	0.18	**P**	A	7.6	7.0	0.8	0.25	A	A
23	Child Dev. Center	7.6	7.8	0.1	0.25	**P**	A	7.6	7.0	0.4	0.40	A	A

TRC . Total Residual Chlorine (mg/L) for EA samples. AAFB measurements are as free residual chlorine (mg/L). During the 16-17 and 30 November 1993 sampling period, AAFB could not detect total residual chlorine when they could detect free residual chlorine. Since free residual is part of the total residual chlorine analysis, these data are considered anomalies and are reported for informational purposes only.

EA-1 EA subcontracted coliform analyses to Gascoyne Laboratories, Inc. Analyses performed by MMO-MUG (Colilert) method, EPA 570/9-90-008A October 1991.

EA-2 EA subcontracted coliform analyses to Martel, Inc. Analyses performed by MMO-MUG (Colilert) Method as well as membrane filtration method. All samples had <1 CFU/100 ml.

AAFB Samples evaluated by Andrews Air Force Base on 16-17 and 30 November 1993 by MMO-MUG (Colilert) Methods. Samples evaluated on 1,8,15,16, and 20 December, 1993 and 26 February 1994 using membrane filtration. Sample MCMG (8 December 1993) had 13 CFU/100 ml and 3780 Louisiana Avenue (8 December 1993) had 2 CFU/100 ml.

(a) Samples collected in collapsible sample bags.

(b) Samples collected in Nalgene bottles.

(c) Samples evaluated using MMO-MUG (Colilert) method.

Note: Site locations correspond to Figures 2-1 and Table 2-1.

P = Coliform Present

A = Coliform Absent

TABLE 2-6 Extended

Site Location	Sample Description	1 December 1993 Coliform Analyses AAFB[a]	8 December 1993 Coliform Analyses AAFB[a]	15 December 1993 Coliform Analyses AAFB[b]	16 December 1993 Coliform Analyses AAFB[b]	20 December 1993 Coliform Analyses AAFB[b]	26 January 1994 Coliform Analyses AAFB	27 January 1994 Coliform Analyses AAFB
1	1889 NCO Club							
2	Hangar No. 2			A	A			
3	1535 BEE	A		A	A			
4	MGMC		**P**	A	A			
5	4638 Poplar Ct.							
6	2086-A							
7	5136 Jerstat Ct.			A	A			
8	2137							
9	Hangar No. 8			A	A	A	A	
10	AF-1							
11	4003							
12	113th HQ	A		A	A			
13	3575							
14	3780 Louisiana Avenue		**P**	A			A	
15	Dining Hall							
16	4782 Command Drive							
17	4753 Fairway							
18	Youth Center			A	A	A	A	
19	4079							
20	4027							
21	4014 Beech							
22	4272 Wilmington							
23	Child Dev. Center			A	A			A[c]

The source of the contamination was either from the storage of the sample bags or the dirty sample transportation container.

Prior to this audit, a 30 September 1993 MDE checklist audit of the Andrews AFB laboratory was conducted. Although several deviations were noted (Appendix A, Section 5.0), the audit concluded that the laboratory was in substantial compliance with the requirements for certification as a water quality laboratory. For this reason, the audit of the analytical procedures did not utilize the MDE checklist. Instead, the analytical procedures were directly observed by the auditor to ensure that the proper procedures were still being performed. The conclusions of the auditor indicated that Andrews AFB was adequately performing the analyses based on MDE requirements. In regard to the deviations noted in the MDE audit, EA is unaware of any corrective actions initiated by Andrews AFB.

In addition, EA interviewed the auditor after the audit report was received. The auditor indicated that MDE spends most of the auditing effort in the laboratory during the laboratory certification effort while the sampling procedures are typically evaluated during the instruction period for certification of the individual drinking water samplers.

The results of the audit strongly suggested that the discrepancies between the side-by-side results of the coliform tests from Andrews AFB (14 positive) and the two independent laboratories (one positive) were a result of contamination during sampling by Andrews AFB. In an effort to determine whether this result was correct, additional testing by Andrews was immediately performed following the improved sampling methods recommended from the audit and the existing sampling methods that were used prior to the audit. These results are also presented in Table 2-6 and indicated that the sampling was the source of positive coliform tests in the base's analysis. As a result, additional sampling and analyses described in the scope of work were delayed until additional data were available from Andrews AFB using the improved sampling procedures. This delay in performing additional analyses was made in an effort to be cost effective. With the exception of the coliform analyses performed on 8 December 1993 (which still employed the collapsible sample bags), Andrews AFB has not observed positive coliform tests in the other sampling periods (Table 2-6). In fact, the samples evaluated on 1 and 8 December employed the procedures that Andrews AFB had been traditionally using. Analyses performed by Andrews AFB using the modified sampling procedures since 15 December 1993 have consistently yielded no positive coliform results. It is important to note that during the period of the positive coliform tests by Andrews AFB, detectable total residual chlorine levels were observed by EA as well as Andrews AFB.

Based on the fact that the two independent laboratories did not observe the degree of positive coliform tests observed by Andrews AFB in the side-by-side analyses, the results of the analytical and sampling audit, and subsequent analyses of samples with no positive coliform results by Andrews AFB using the improved sampling procedures, it appears that sampling was the source of the positive values.

2.5.5 Additional Chlorine Sampling

Twelve additional locations were sampled to provide more information on the dead-end loops around the base (Figure 2-1). This sampling was performed by EA on 16 and 21 December utilizing the amperometric titration methods described in Section 2.5.3.1. The results are presented in Table 2-7. Detectable residual chlorine values were found at all locations; however, flushing of these dead-end lines improved the residual chlorine levels in the dead-end. Thus, a more rigorous flushing program will provide a level of safety for ensuring higher residual chlorine levels in the distribution system. However, several locations did not increase substantially for residual chlorine levels after flushing; this may be due to limited flushing effectiveness resulting from less than sufficient flushing duration (3 minutes).

2.5.6 Chlorine Spiking Study

An additional study was performed in order to evaluate whether increasing the residual chlorine level by Andrews AFB in order to achieve better disinfection capabilities within the distribution system would contribute to elevated levels of trihalomethanes (e.g., chlorinated organic compounds such as trichloroethylene, a regulated constituent having a maximum level in drinking water of 0.005 mg/L). This, in effect, would result in exchanging one potential problem for another.

To address this question, EA collected water from Site 3 (1535 BEE) on 9 November 1993. The sample was collected using the same methodology used in Section 2.4.2.1 with the exception that 1 gal of sample was collected. The sample was transported to EA's Sparks, Maryland laboratory on wet ice where it was stored at 4°C in the dark until used for testing.

Four 1-L glass test chambers were used for the study, each containing 500 ml of the sample. Three of the test chambers were dosed with sodium hypochlorite in order to achieve TRC concentrations of 4.11, 6.23, and 9.35 mg/L, as measured by amperometric titration (EPA 330.1). The fourth test chamber served as an unspiked control. Immediately upon dosing the test chambers with the sodium hypochlorite and the subsequent analysis of the test

TABLE 2-7 RESIDUAL CHLORINE CONCENTRATION FROM SELECTED SITES AT ANDREWS AFB BEFORE AND AFTER FLUSHING OF DISTRIBUTION SYSTEM, DECEMBER 1993

Site Location	Sample Description	16 December 1993		21 December 1993
		FRC (mg/L)	TRC (mg/L)	TRC (mg/L)
25	Joplan/Boises	0.34	0.58	0.79
	After Flush	0.61	0.85	0.82
34B	2355 Watertown	<0.01	0.02	0.06
34A	After Flush	0.53	0.81	0.78
33	2326	0.02	0.04	<0.01
	After Flush	0.02	0.09	0.44
32	Famcamp	0.04	0.04	0.03
	After Flush	0.07	0.10	0.21
30	4089	0.04	0.16	0.18
	After Flush	0.03	0.13	0.12
**29	Yuma	0.02	0.02	0.18
	After Flush	0.03	0.12	0.06
31	Dayton/Cedar	0.04	0.04	0.01
	After Flush	0.05	0.20	0.28
27	Greenhouse	0.03	0.03	0.08
	After Flush	0.04	0.18	0.24
28B	1025	0.01	0.08	0.11
28A	After Flush	0.03	0.15	0.16
26	1289	0.28	0.49	1.08
	After Flush	1.10	1.48	1.81
**35	Flight Deck (Hangar 15)	0.08	0.08[a]	<0.01
	After Flush	0.09	0.09[a]	0.01
24	US Army Reserves	0.04	0.04[a]	0.09
	After Flush	0.07	2.00	0.56

FRC = Free Residual Chlorine in mg/L.
TRC = Total Residual Chlorine in mg/L.
(a) No additional residual chlorine was observed in these samples. The total residual chlorine was normalized to the level of the free residual chlorine concentrations.
** Denotes dead-end loops where flushing did not substantially increase the concentration of TRC for both sampling periods.
Note: Site locations correspond to Figure 2-1 and Table 2-1.

chamber for TRC, and aliquot of sample was removed from the chamber, placed in the appropriate sample container and analyzed for trihalomethanes according to EPA Method 524.2 (EPA 1979).

Table 2-8 summarizes the results of this spiking study. It is important to note that increasing the TRC concentration of the sample with sodium hypochlorite did not increase the concentration of the drinking water regulated trihalomethanes. The analysis of dibromochloromethane observed in the unspiked sample (22 μg/L) appeared to actually decrease in concentration for the spiked samples. However, another explanation may be that the 22 μg/L concentration observed in the control may actually be a data point outlier.

Review of the water quality data obtained from WAD and WSSC indicates that trihalomethanes should not be a problem for Andrews AFB from either water source with the exception of water from WAD's McMillan WTP. On the most recently available data (1992), the McMillan WTP had an average of 59 μg/L trihalomethanes and a maximum of 120 μg/L (from August 1992). However, this plant was generally below the State of Maryland regulated level of 100 μg/L trihalomethanes.

TABLE 2-8 ELEVATED CHLORINE SPIKING STUDY OF ANDREWS AFB TAP WATER FOR THE REGULATED DRINKING WATER TRIHALOGENATED METHANE COMPOUNDS

Parameter (μg/L)	Control[(a)]	Chlorine Spike A[(b)] (4.11 mg/L TRC)	Chlorine Spike B (6.23 mg/L TRC)	Chlorine Spike C (9.39 mg/L TRC)
Dichlorodifluoromethane	<1	<1	<1	<1
Dichlorofluoromethane	<1	<1	<1	<1
Chloroform	37	32	32	31
Bromodichloromethane	11	10	9	9
Dibromochloromethane	22	2	2	2
Bromoform	<1	<1	<1	<1

(a) Control water was collected from Site 3 (1535 BEE) on 9 November 1993 at 1000 hours.

(b) Chlorine spikes were achieved by spiking the control water with a stock solution of sodium hypochlorite to achieve the desired total residual chlorine concentration (TRC). TRC was measured using amperometric titration method (EPA 330.1).

3. RECOMMENDATIONS

This section addresses the recommendations of this study. The primary recommendation relates to modifications to protocol for coliform sampling. Additional recommendations, however, are made relating to system operation and maintenance. Additional discussion is also presented related to actions that should be implemented in the event coliform-positive levels are detected in the future.

3.1 SAMPLING AND ANALYSIS PROCEDURES

The sampling procedures used by Andrews AFB for the total coliform analyses were the major reason for the historical high level of positive coliform. Based on the observations and results from the side-by-side sampling/analytical evaluation between Andrews AFB and EA, as well as observations obtained during the audit of the sample collection and handling procedures, EA has provided additional information to serve as a supplemental protocol (Table 3-1). While this protocol outlines many items that should be considered for sampling and analysis, it should not be misconstrued as indicating that various aspects of Table 3-1 were not being performed by Andrews AFB. This protocol incorporated the necessary changes in the sample collection and handling practices at Andrews AFB in order to ensure that sampling bias will be kept to a minimum and long-term compliance with Maryland drinking water requirements will be met.

As discussed in Section 2.5.4.2, the overall sample collection and analysis followed a protocol that was approved by MDE. However, during side-by-side analyses and the audit of Andrews AFB, several inconsistences in sampling were observed.

In general, the field sample storage and transport container (i.e., plastic cooler) and the non-sterile handling and storage of the collapsible sample bags were identified as the primary source of sample contamination. Any sample container or equipment that come into contact with drinking water samples must be clean and carried independent of previously collected samples; they should be discarded if they are compromised.

Samples should be collected only from an interior tap whenever possible (APHA et al. 1992). Andrews AFB frequently used exterior taps for many of the samples. However, because of splashing, water storage in hoses, etc., it is more desirable to sample from an interior high-use tap such as a bathroom. If a sample is to be collected from an exterior tap, it should never be collected from a hose. Whenever possible, the tap should be

sterilized with a sodium hypochlorite swab or flame prior to sampling. Using *Standard Methods* (APHA et al. 1992) recommendation, the cold tap should be run 2-3 minutes prior to sampling. If the tap is a temperature mixing faucet, the hot water should be run for 2-3 minutes, followed by 2-3 minutes on cold, and then the sample should be collected. Water samples should never be collected from the bathtub/shower or kitchen faucet because of the high potential for bacteria. If samples are required from these locations, the outside of the tap should be sterilized prior to sample collection.

The use of the collapsible sample bags by Andrews AFB prior to analysis is performed by untwisting the container, then pouring the sample from the packs over the twist tie end that has been exposed to external water and handling. If bacteria are present on the outside of the containers, it can lead to contamination of the sample. When samples are poured from the sample bag, it should be directed to flow over the broad edge of the containers.

While collapsible sample containers are routinely used by many organizations evaluating the presence of coliforms in drinking water samples, they require an experienced person for the collection and handling of the samples. Should Andrews AFB feel that due to rotating staff, the necessary expertise may not always be available for proper sample collection and handling, hard sterile bottles containing thiosulfate should be used. At a minimum, it is EA's recommendation that both sample bags and bottles should be used in parallel for a period of time to ensure sample collection integrity. The use of sample bottles, rather than sample bags, on a random basis would also ensure that the proper sample handling is being employed. EA also recommends the use of trip blanks and field blanks (Table 3-1) be incorporated into the sampling program.

The costs of implementing these recommendations are largely procedural and should be negligible.

3.2 MAINTENANCE PROGRAM

3.2.1 <u>Flushing Program</u>

A flushing program is recommended at all dead-ends (sampling location nos. 24-35, as shown on the drawing included with this report). It is recommended that these locations are flushed initially on a monthly basis and analyzed for free chlorine residual and water turbidity both before and after sampling. This frequency is selected on an arbitrary basis but can be increased or decreased based on the results of testing to ensure maintenance of a free

TABLE 3-1 SAMPLE COLLECTION PROTOCOL

1. OBJECTIVE

This protocol is intended to provide the necessary technical guidance in order to collect and handle drinking water samples for microbiological examination. It is not intended to be "cookbook" protocol rather than guidance for the sample collection process. This information should be used in addition to the protocol already established by Andrews AFB entitled, "Bacteriological Examination of Drinking Water Procedures," presented in Appendix E of this report.

2. CONTAINERS

Samples should be collected in plastic bottles that have been cleaned and carefully rinsed. These bottles should be sterilized (with caps loosened to prevent distortion) in an autoclave at 121°C for 15 minutes (see Standard Methods, APHA et al. 1992 for additional sterilization techniques). Presterilized sample bags may also be used for sample collection; however, care should be used in storing the containers in order to maintain the sterilized condition of the bags. Presterilized plastic bags containing sodium thiosulfate ($Na_2S_2O_3$) are commercially available.

3. SAMPLING PROCEDURE

When a sample is to be collected from a distribution system tap without attachments, select a tap that is supplying water from a service pipe directly connected with the main and not served from a storage tank or cistern. Open the tap fully, and allow the water to flow freely for 2-3 minutes, or for a time sufficient to permit clearing the service line. After this time frame, reduce the water flow sufficiently to permit filling the sample bottle, or sample bag, without splashing. If the cleanliness of the tap is in question, apply a solution of sodium hypochlorite (100 mg/L) to the tap prior to sampling, and let the water flow for an additional 2-3 minutes after treatment. Samples collected from temperature mixing faucets should be collected after removal of faucet attachments such as screen or splash guard by running the hot water for 2-3 minutes, then cold water for 2-3 minutes, and then collecting the sample.

Samples should be collected from locations outlined in the most current sampling plan for monitoring of public drinking water systems, as regulated by the State of Maryland Department of the Environment (i.e., Andrews AFB Sampling Plan dated 4 February 1991). This plan outlines a sampling schedule for drinking water sampling from various locations on a weekly basis during each month, with nine representative samples collected monthly.

4. DECHLORINATION

A reducing agent should be added to containers intended for the collection of water having residual chlorine, or other halogens. Sodium thiosulfate ($Na_2S_2O_3$) is the most commonly-used reducing agent and prevents continuation of bactericidal action during sample transit.

For drinking water samples, the concentration of dechlorinating agent should be 0.1 ml of a 3 percent solution in a 120-ml sample bottle, which should give a final concentration of 18 mg/L. This concentration will neutralize a sample with up to 5 mg/L residual chlorine. As stated earlier, sample bags impregnated with reducing agent are commercially available.

5. SAMPLE VOLUME

The volume of sample should be sufficient to complete all of the necessary tests required, including the quality control aspects of the program such as duplicates, etc. Typically, a minimum of 100 ml of sample should be collected; however, more sample volume can be collected, based on the study objectives. When the sample is collected, ample air space in the bottle should remain in order to facilitate mixing by shaking before examination.

6. SAMPLE HANDLING

After sample collection, the second most important aspect of sampling is the handling of the sample after collection. Sample containers should be kept on wet ice or "blue ice" in a storage/transportation container (i.e., cooler) that is sterilized prior to sample transport with sodium hypochlorite (100 mg/L). Should blue ice be used, this container should also be sterilized. The sample temperature should be maintained <10°C and should be processed within six hours of sample collection whenever possible. For certain split samples, etc., the six-hour holding period may not be practical, but all samples should be processed within 24 hours of sample collection.

After collecting the water sample, the container should be labeled with the sample location, date of sample, sampler's name, and required analysis. Should several samples be collected using plastic bags from one location, they should be grouped using a precleaned and sterilized ziploc bag prior to placing in the storage/transportation container.

<u>Caution:</u> Only items that are precleaned and sterilized should come into contact with the outside sample containers. In addition, nothing should come in contact with the inside of the sterilized sample container (i.e., sampler's hands or fingers), nor should the sampler blow into the plastic bag to inflate the container.

7. ADDITIONAL SAMPLES FOR QUALITY ASSURANCE

In order to provide the necessary level of quality assurance to ensure that bias of the drinking water samples for coliform analysis is kept to a minimum, three types of quality assurance samples can be employed.

TABLE 3-1 SAMPLE COLLECTION PROTOCOL (Cont.)

7.1 Sample Duplicate

This is an additional sample that is collected from a predetermined location and processed as a separate sample. It is recommended that a sample duplicate be collected at least once per sample period, or not less than one every 20 samples.

7.2 Trip Blank

This is a sample that is prepared using sterilized laboratory water in the laboratory prior to sample collection. This sample is taken into the field and handled the same as samples collected in the field. It is recommended that a trip blank be incorporated at least once a month; however, a weekly use of trip blanks would be more beneficial.

7.3 Field Blank

Field blanks are samples processed in the field using sterilized laboratory water. This sample differs from trip blanks because it not only evaluates the sample handling in the field, but also attempts to evaluate the sampler's technique. A field blank is performed by placing the sterilized laboratory water in the sample containers in the field environment. It is recommended that a field blank be incorporated at least once a month; however, a weekly use of field blanks would be more beneficial.

8. POSITIVE COLIFORM TESTS

Should a positive coliform test be determined, the sampling (as well as analytical) procedures should be reviewed to determine if there was any reason for the sample containers to be contaminated. This data quality review should be accomplished by reviewing the sample duplicates in addition to the trip or field blanks, if available. It is also helpful if the person who collected the samples is interviewed to determine sample quality. Should sample quality be undetermined, the sample should be immediately resampled. If a problem in sample collection or handling is determined, the sample should not be resampled until the problem is corrected.

9. ADDITIONAL INFORMATION

American Public Health Association, American Water Works Association, Water Environment Federation, 1992. *Standard Methods for the Examination of Water and Wastewater*. 18th edition. APHA, Washington, D.C.

chlorine residual of 0.2 mg/L. The period of flushing depends on the time to displace water in the line being flushed (between the normally flowing supply line and the flushing point). Assuming a flow of 5 ft/sec and a maximum flushing length of 0.5 mi, this provides for an approximate minimum flushing time of 10 minutes. For conservation, a flushing period of 20 minutes is recommended; this can be changed based on results of chlorine residual testing. Initially, it is anticipated that this program will require two Air Force personnel one day per month. This estimated personnel requirement will vary as the flushing program is modified.

In addition, the base should implement a valve management program in accordance with AWWA C500-86, Section A.6, consisting of opening and closing all valves once per year to ensure valves are in the correct position and do not stick. EA did not inventory the valves. Based on previous experience, it is estimated that a crew of two persons can exercise approximately 20-30 valves in one day.

3.2.2 Cleaning and Lining

Cleaning and cement mortar lining of old cast-iron water lines is considered to be a maintenance procedure by local water purveyors. This is generally to maintain fire-fighting capacity in the old lines and extend the useful life of the system. In addition, it will remove from the system tubercles that may harbor coliform bacteria. However, conclusion of this report is that there is no evidence of contamination within the present distribution system. EA does not therefore recommend cleaning and lining at this time.

3.3 LOOPING OF DEAD-ENDS

Several of the remaining dead-ends in the water system have experienced residual chlorine levels below the recommended level of 0.2 mg/L. However, implementation of a systematic flushing program discussed above is expected to alleviate this problem. Furthermore, there is no evidence that coliform-positive values are resulting from dead-ends. Thus, based on the findings and recommendations of this study, there is no evidence to indicate that dead-ends should be looped. However, it is recommended that looping dead-ends be continued as appropriate and practical as part of a continuing program to upgrade the water system. By so doing, an added degree of protection will be achieved against future coliform-positive occurrences.

3.4 CROSS-CONNECTIONS

There is no evidence to indicate that cross-connections are causing a coliform contamination problem. However, it is EA's understanding that there are cross-connections on base that are not included in the CCCP. For this reason and because the last cross-connection control and backflow prevention devices inventory was conducted more than 3 years ago, EA recommends a comprehensive update of the CCCP upon its expiration in August 1994. This update should incorporate all cross-connections to the water system, including those cross-connections maintained by the Navy and Air National Guard units on-base. An integral part of any CCCP is the regular testing and maintenance of all cross-connections. The testing and maintenance of cross-connections is mandated by Air Force Regulation 91-26.

3.5 RESIDUAL CHLORINE MONITOR

If the results of the flushing program indicate that residual chlorine levels are not maintained above the minimum value, EA recommends that a residual chlorine monitor be installed, to be located at a point on the western side of the base, where residual chlorine levels have historically been lowest. The unit should be located in the vicinity of an electric source to provide power, possibly at the intersection of Wheeling Road and Wisconsin Road.

The unit would serve as a continuous monitor of residual chlorine in the main supply loop which, when combined with a systematic flushing program, would provide Andrews AFB with a comprehensive understanding of chlorine residual throughout the system. The unit would also provide a continuous, amperometric measurement of free or total chlorine residual, as required. The unit should include a 30-day strip chart recorder with high and low setpoint alarms. The installed cost is approximately $50,000 (assuming a local power supply).

3.6 WATER SUPPLIER

Based on a review of water quality records, it is recommended that Andrews AFB continue to receive its water from WSSC. While both suppliers are a good water source, WSSC consistently provides slightly higher quality water when evaluated for trihalomethanes and total coliform. In addition, there is no cost savings from purchasing water from WAD, as they are required to charge customers within WSSC's service area at the same rate as WSSC.

While EA was not tasked to perform a fire flow analysis for the base water system, it is noted that the Greenhorne and O'Mara report (1990) identified a shortfall in demand to meet the year 2000; implementation of their recommendations should substantially alleviate the fire flow problem. Based on their findings, the capital cost for the necessary upgrade to continue with the WSSC water supply would be approximately $123,000.

3.7 PROGRAM IN THE EVENT OF RECURRENCE OF COLIFORM CONTAMINATION

All analytical work conducted by EA occurred during cool weather. However, results presented earlier in this report indicate that there is no evidence of a seasonal variation in coliform levels in the potable water system. Consequently, EA believes that there is also no evidence to indicate that the recommendations presented in this section should be different under warm weather.

However, should Andrews AFB experience a return of coliform contamination, a program has been developed to evaluate the problem. This program is intended to serve as an outline approach that can be adapted to the specifics of the problem, and is presented in four phases in a sequential manner. Figure 3-1 presents the phases graphically. During the first and second phase, sampling and analytical procedures are evaluated; in the third phase, maintenance and procedural problem sources are identified; and in the fourth phase, the potential of a major system problem is addressed. Each phase is discussed below.

Phase I: Initial Investigation and Validation

Under this phase, the coliform analysis flow chart determines if a coliform contamination problem is detected during routine sampling of the water system. If the samples collected are coliform negative, the result is reported, and the sampling event is completed. If the sample is coliform positive, the sampling event is repeated in accordance with COMAR 26.04.01.11-2. The repeat sampling provides validation of the coliform-positive result. If repeat sampling indicates similar coliform-positive results, the quality of the sampling results is evaluated by the procedure outlined in Phase II.

Phase II: Evaluation of Data Quality

If coliform-positive results are validated, the next phase evaluates the validity of these results by conducting quality control checks of Andrews AFB sampling and analysis procedures.

This will determine if field sampling or laboratory analytical procedures are the source of erroneous coliform-positive results. The quality control checks involve utilizing field and trip blanks to determine if samples are collected and transported properly, and implementing positive and negative controls to validate laboratory protocol. If coliform-positive results reappear after incorporation of the quality control checks, the quality of sampling and analysis is considered acceptable. Otherwise, Phase III is initiated to isolate the source.

Phase III: Isolation of Coliform Contamination Source

Phase III attempts to isolate the source of contamination on the base by additional sampling at preselected locations. This may involve repeated sampling to determine locations that consistently test coliform positive. Once the source has been identified, the appropriate corrective actions can be implemented. Following are possible actions:

- implementing flushing procedures;
- repairing leaks;
- repairing cross-connections; and
- looping dead-ends.

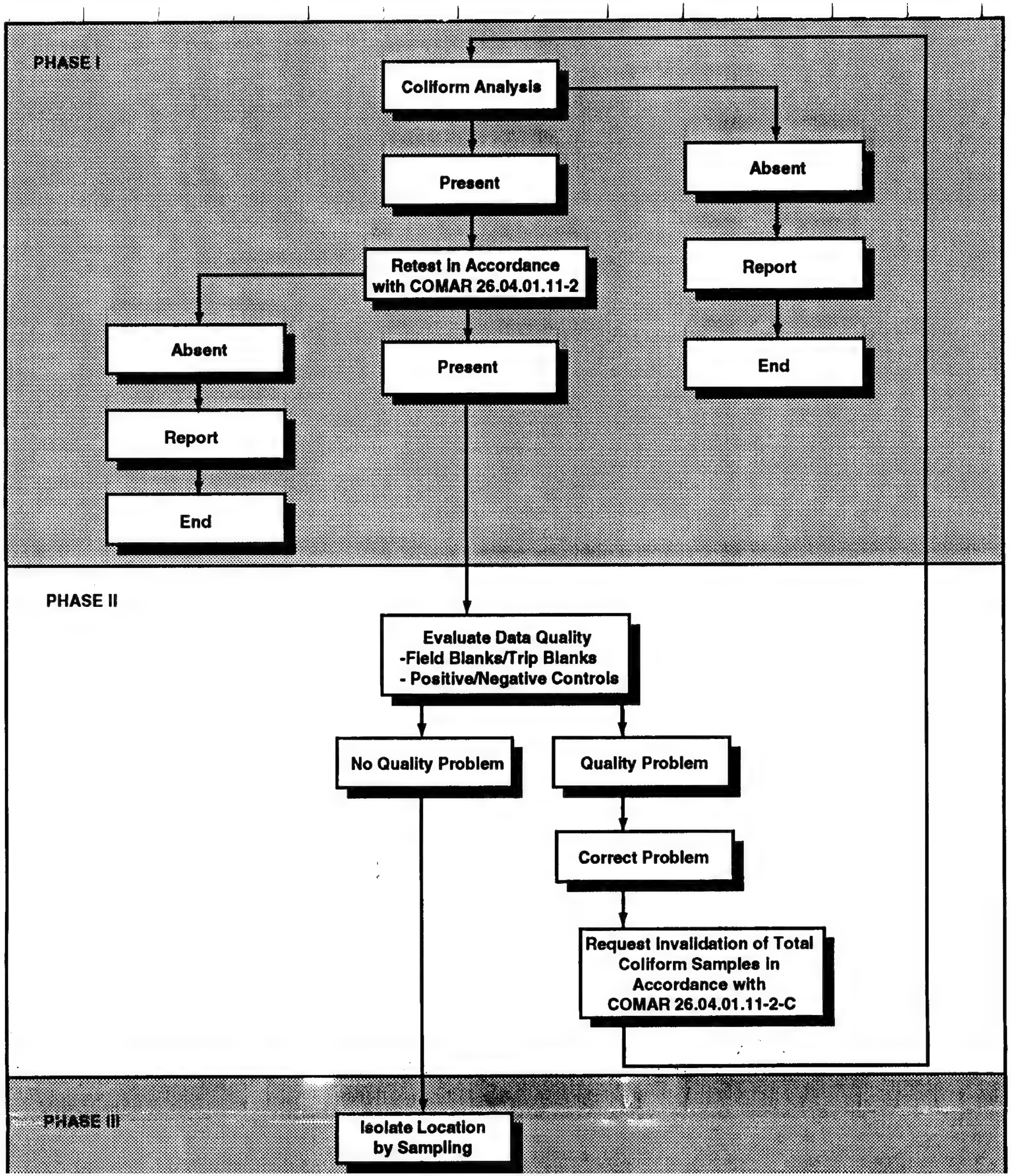
After corrective actions are initiated, the location is retested for coliform. If sampling continues to display coliform-positive results, the next phase is initiated.

Phase IV: Evaluation of Water System

This phase includes reviewing water supplier coliform and residual chlorine levels. If the water quality data indicate that the supplier is the source of contamination, the following corrective actions may be implemented:

- boost chlorine levels; and/or
- change supplier.

Otherwise, a systematic review of the water system is required. This program will be specific to the problem at hand and cannot be defined further at this time.


PHASE I
Coliform Analysis
Present
Absent
Report
End
Retest in Accordance with COMAR 26.04.01.11-2
Absent
Report
End
Present
PHASE II
Evaluate Data Quality
-Field Blanks/Trip Blanks
- Positive/Negative Controls
No Quality Problem
Quality Problem
Correct Problem
Request Invalidation of Total Coliform Samples in Accordance with COMAR 26.04.01.11-2-C
PHASE III
Isolate Location by Sampling

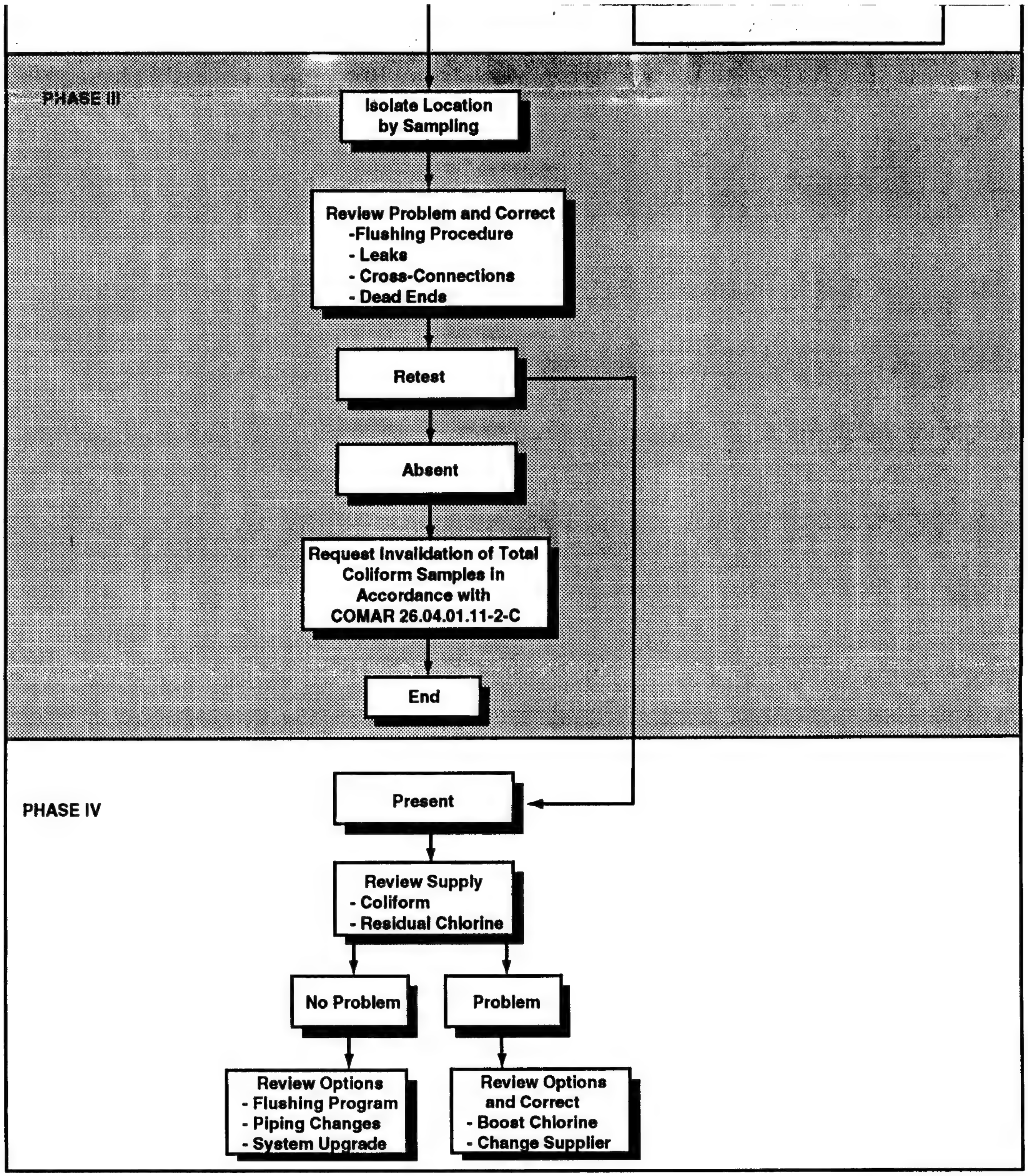


Figure 3-1. Coliform Analysis Flowchart.

REFERENCES

American Public Health Association (APHA), American Water Works Association (AWWA), Water Environment Federation. 1992. *Standard Methods for the Examination of Water and Wastewater.* 13th edition. APHA, Washington, D.C.

COMAR Title 26, Subtitle 04, Chapter 01. Department of the Environment; Regulation of Water Supply, Sewage Disposal, and Solid Waste; Quality of Drinking Water in Maryland.

U.S. Environmental Protection Agency (EPA). 1979. *Methods for Chemical Analysis of Water and Wastes.* EPA-600/4-79/020. EPA, Cincinnati, Ohio.

U.S. Environmental Protection Agency (EPA). 1991. *MMO-MUG (Colilert) Method for Assessment of Coliforms.* EPA 570/9-90-008A. EPA, Cincinnati, Ohio.

APPENDIX A

INVENTORY OF RELEVANT DOCUMENTATION

APPENDIX A

INVENTORY OF RELEVANT DOCUMENTATION

1.0 Sampling Plan 1991

2.0 Reservoir Repair and Chlorination
- Talking Paper on Base Drinking Water Chlorine, 2/26/93
- Quality of Drinking Water, August 1992
- Evaluation of Drinking Water Disinfection, 12/14/92

3.0 Pre-Survey on Base Drinking Water
- Pre-Survey on Base Drinking Water, August 1992
- Reply to Pre-Survey on Base Drinking Water, 11/12/92

4.0 Coliform Contamination Reappearance
- March 1, 1993 Lab Results and Public Notice
- Talking Paper on Upgrade of Bacterial Contamination of Base Drinking Water, 7/27/93

5.0 Laboratory Data and Sampling Results
- EA Laboratory Data Report—Trihalomethanes, 11/11/93
- Gascoyne Total Coliform Results, 11/16/93
- AAFB/EA Side-by-Side Total Coliform Results, 11/30/93 (AAFB Results)
- Martel Total Coliform Results,. 11/30/93
- AAFB/EA Side-by-Side Chlorine Residual Results, 11/30/93 (AAFB Results)
- AAFB Total Coliform Sampling Results (EA Modified), 12/1/93-12/20/93
- AAFB Total Coliform Sampling Results, January 1994
- MDHMH Reports of an Interim Survey of Bioenvironmental Engineering Water Laboratory, 6/29/93 and 9/30/93
- Martel Lab and Sampling Audit, 12/14/93
- Martel Telecon, 2/7/94

6.0 Cross Connection Control Plan
- CCCP Submittal to MDNR, 3/12/91
- CCCP Acceptance by MDNR, 3/26/91
- CCCP Telecon, 12/10/93

7.0 Miscellaneous Correspondence
- Fire Reserve, 11/16/93
- WAD Acute Contamination Telecon, 12/2/93
- EA Letter, 12/16/93

1.0 SAMPLING PLAN 1991

Rec'd 12-13-93

DEPARTMENT OF THE AIR FORCE
MALCOLM GROW USAF MEDICAL CENTER (MAC)
ANDREWS AIR FORCE BASE DC 20331-5300

4 February 1991

REPLY TO ATTN OF: SGPB

SUBJECT: Public Drinking Water System Written Sampling Plan

TO: State of Maryland
Department of the Environment

1. Malcolm Grow Medical Center, Bioenvironmental Engineering Services (BES) has reviewed the drinking water quality monitoring program required by the State of Maryland Department of the Environment effective December 31, 1990. As a public water system owner/operator we have written a sampling site plan subject to the State of Maryland Department of the Environment review and revision for the following sites.

a. Andrews Air Force Base, Maryland Identification Number 016-0021 (see Atch 1).

b. Brandywine Family Housing, Maryland Identification Number 016-0022 (see Atch 2).

c. Brandywine Communication Site, Maryland Identification Number 116-0037 (see Atch 3).

d. Davidsonville Family Housing, Maryland Identification Number 002-0050 (see Atch 4).

e. Davidsonville Communication Site, Maryland Identification Number 102-0086 (see Atch 5).

The sampling plan includes a monitoring schedule for total coliform bacteria, volatile organic chemicals, organic chemicals, inorganic chemicals, and radionuclides. Each attachment has been written as a stand-alone plan to be posted at each site for inspection and review.

2. If you have any questions, please call Lt MacConnell at 981-2559/3380.

RICHARD N. MACCONNELL, 2Lt, USAF, BSC
Bioenvironmental Engineer

5 Atchs
1. Andrews AFB Plan
2. Brandywine Housing Plan
3. Brandywine Site Plan
4. Davidsonville Housing Plan
5. Davidsonville Site Plan

ANDREWS AIR FORCE BASE WRITTEN SAMPLING PLAN FOR THE MONITORING OF PUBLIC DRINKING WATER SYSTEMS AS REGULATED BY THE STATE OF MARYLAND DEPARTMENT OF THE ENVIRONMENT

1. Location: Maryland, Prince Georges County, East of the intersection at Allentown Road and Branch Avenue.

2. Maryland Identification Number: 016-0021

3. Evaluation: Andrews Air Force Base (AFB) serves approximately 7,600 residents. There is one water distribution loop on base with approximately 1,150 service connections (based on number of buildings). Andrews AFB receives water from the Potomac River through systems operated by the US Army Corps of Engineers, Washington Aqueduct Division (WAD) and routed through the District of Columbia. Primary water treatment is accomplished by WAD's Dalecarlia water treatment plant in Montgomery County. Andrews AFB civil engineering squadron adds chlorine and pressure where the water comes on base. This system is defined as a Public Drinking Water System (PDWS) and a Community Water System (CWS).

Base computer provided reference Andrews AFB Economic Resource Impact Statement FY 89 p. 22 which stated 7,585 people live on base. Lori

4. Monitoring Schedule.

a. Total Coliform Bacteria

(1) By definition; nine (9) representative samples per month as follows:

a. Week 1:

- Security Police Operation (Bldg 1845)
- 113 TFW Headquarters (Bldg 3252)

b. Week 2:

- Bioenvironmental Engineering Services (Bldg 3575)
- Malcolm Grow Medical Center (Bldg 1050)

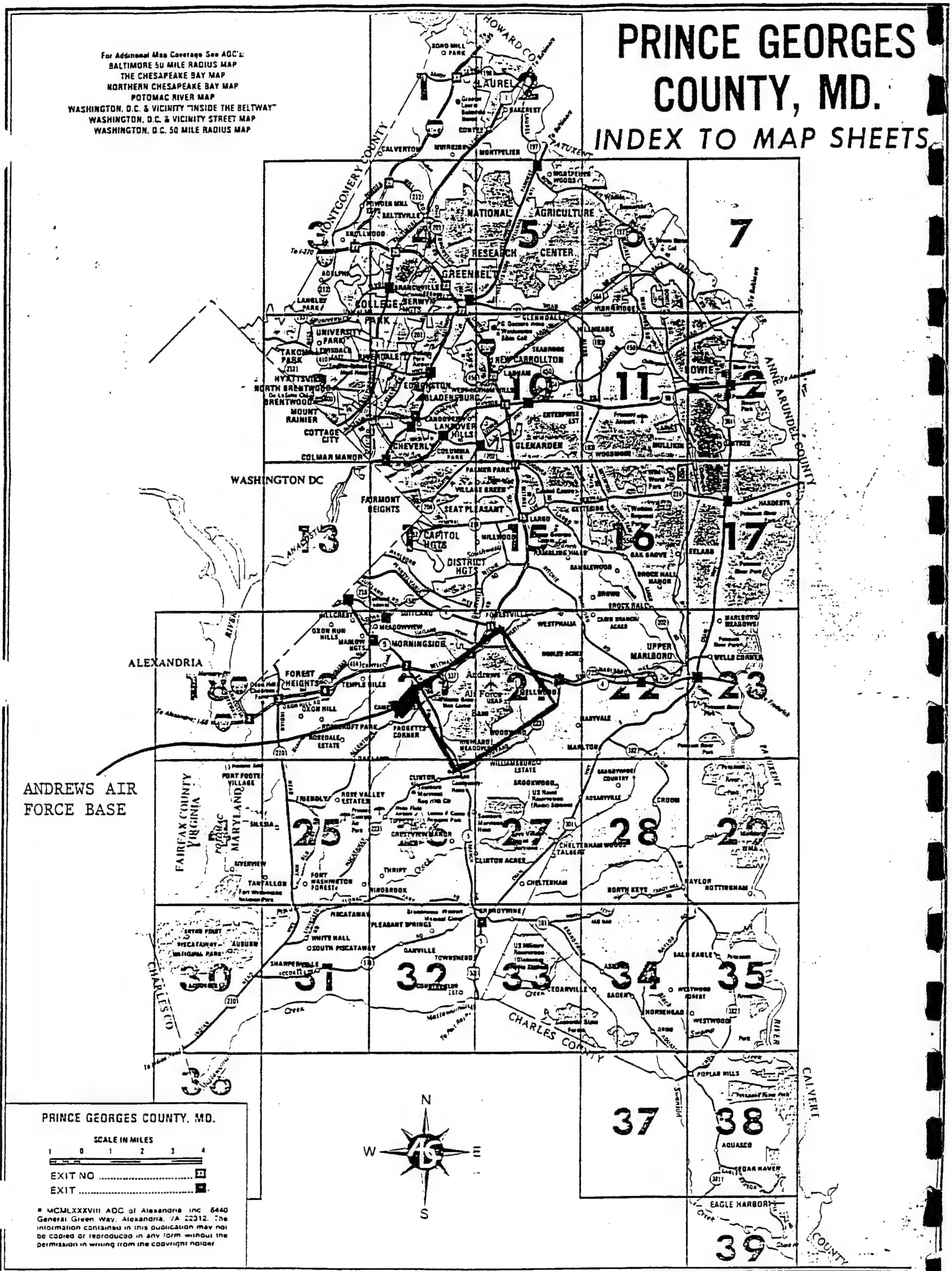
c. Week 3:

- Fleet Services, Hangar 2 (Bldg 1794)
- Child Development Center (Bldg 4575)

d. Week 4:

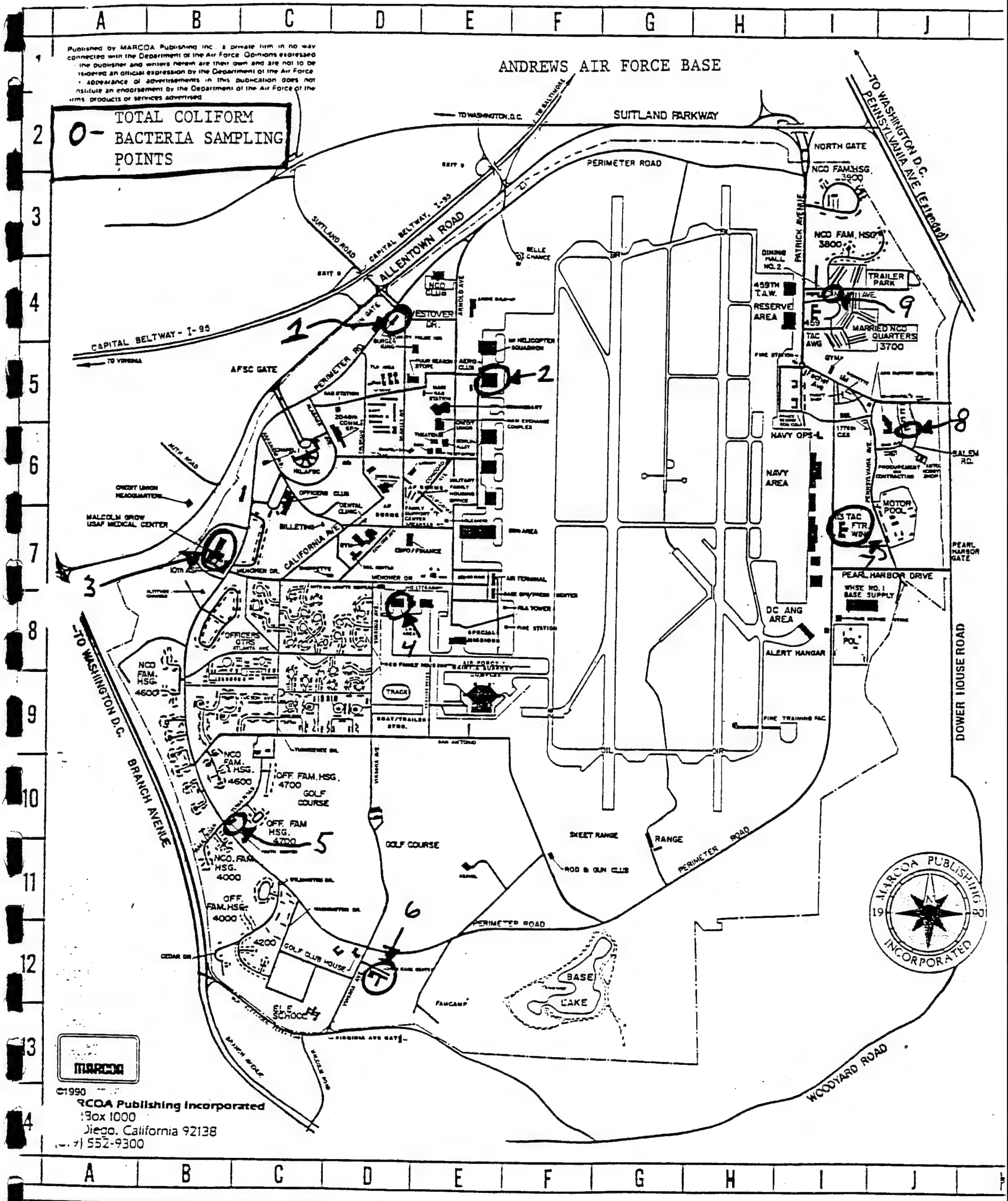
- Dining Hall (Bldg 3763)
- Youth Center (Bldg 4700)
- Det 1, DCANG, Hangar 8 (Bldg 1225)

b. Analysis for Volatile Organic Chemicals (VOC's), inorganic chemicals, and organic chemicals are accomplished monthly be the Dalecarlia Laboratory. Radionuclides are accomplished quarterly by the Dalecarlia Laboratory. As of February 1991, results of these tests will be mailed monthly to the Bioenvironmental Engineering Services (BES) Office at Andrews AFB, MD for analysis then forwarded to the State of Maryland Department of the Environment for review.



See Map Page 1 for "MAP LEGEND"   See Map Page 39 for "METRO RAIL SYSTEM"

Stock No.



ANDREWS AIR FORCE BASE
Published by MARCOA Publishing Inc., a private firm in no way connected with the Department of the Air Force. Opinions expressed by the publisher and writers herein are their own and are not to be considered an official expression by the Department of the Air Force. The appearance of advertisements in this publication does not constitute an endorsement by the Department of the Air Force of the firms, products or services advertised.
O- TOTAL COLIFORM BACTERIA SAMPLING POINTS
A
B
C
D
E
F
G
H
I
J
SUITLAND PARKWAY
PERIMETER ROAD
CAPITAL BELTWAY - I-95
ALLENTOWN ROAD
SUITLAND ROAD
TO WASHINGTON D.C. PENNSYLVANIA AVE
NORTH GATE
NCO FAM. HSG. 3900
NCO FAM. HSG 3800
TRAILER PARK
PATRICK AVENUE
DINING HALL NO. 2
459TH T.A.W.
RESERVE AREA
MARRIED NCO QUARTERS 3700
TAC AWG
NCO CLUB
WESTOVER DR.
ARNOLD AVE
AFSC GATE
AERO CLUB
CREDIT UNION HEADQUARTERS
MALCOLM GROW USAF MEDICAL CENTER
OFFICERS CLUB
BILLETING
CALIFORNIA AVE
DENTAL CLINIC
MENOHER DR
NAVY OPS
NAVY AREA
MOTOR POOL
113 TAC FTR WG
SALEM RD.
PEARL HARBOR GATE
PEARL HARBOR DRIVE
WHSE NO. 1 BASE SUPPLY
POL
DC ANG AREA
ALERT HANGAR
AIR TERMINAL
FIRE STATION
SPECIAL MISSIONS
OFFICERS QTRS
NCO FAM. HSG. 4600
TRACK
BOAT/TRAILER STOR.
FIRE TRAINING FAC.
DOWER HOUSE ROAD
TO WASHINGTON D.C.
BRANCH AVENUE
OFF. FAM. HSG. 4700
GOLF COURSE
OFF. FAM HSG. 4700
NCO. FAM HSG. 4000
OFF. FAM. HSG. 4000
SKEET RANGE
RANGE
ROD & GUN CLUB
PERIMETER ROAD
GOLF CLUB HOUSE
ELE. SCHOOL
FAMCAMP
BASE LAKE
WOODYARD ROAD
MARCOA PUBLISHING INCORPORATED 1990
1
2
3
4
5
6
7
8
9
MARCOA
©1990
MARCOA Publishing Incorporated
Box 1000
San Diego, California 92138
(619) 552-9300

<u>NOTE</u> - One (1) aircraft watering point and two (2) aircraft watering trucks in Bldg 5016 (Presidential Hangar) are not used. If used, they will be sanitized by Fleet Services then tested for bacti by BES. As per telephone conversation 31 Jan 91 between Lt MacConnell (BES) and SMSgt Michael Carney, 93rd APS/TROS Aircraft Services Superintendent.

*** This plan is to be reviewed no later than December 1991 to ensure implementation by 1 January 1992.

Andrews Air Force Base
Bioenvironmental Engineering Services

Drinking Water Sampling Schedule for 1993

PERIOD	SITE	BLDG/ UNIT	DESCRIPTION	ANALYSIS REQUIRED
WEEK 1	AAFB	1535	BEE Lab	1,2
	AAFB	3252	113th TFW Headquarters	1
	BFH	3	Residence	1,2
	BFH	9	Residence	1
	BCS		Main Receiver Building	1,4
WEEK 2	AAFB	1050	Malcolm Grow Medical Center	1
	AAFB	3790-3	Lousiana Ave. - Residence	1,2
	DFH	~~3013~~ 3/2	Residence	1,2
	DCS		Main Receiver Building	1,4
WEEK 3	AAFB	1794	Hangar 2, Aircraft Watering Point	1
	AAFB	5136-A	Jersted Court - Residence	1,2
WEEK 4	AAFB	1225	Hangar 8, Aircraft Watering Point	1
	AAFB	3763	Dining Hall	1
	AAFB	4700	Youth Center	1,2

Sampling Points NOT Reportable To The State:

WEEK 3	AAFB	1794	Water Truck No. 80	1,3
WEEK 3	AAFB	1794	Water Truck No. 97	1,4
WEEK 3	AAFB	5016	Aircraft Watering Point	1
WEEK 3	AAFB	5016	COMBS Water Truck Nos.	1,5
WEEK 4	AAFB	1225	Water Truck No. 47	1,5
WEEK 4	AAFB	4575	Child Development Center	1

NOTE - All samples are to be collected and analyzed MONTHLY unless otherwise noted.

KEY:

1 - Total Coliform Bacteria
2 - Flouride
3 - Only in Jan/Apr/Jul/Oct
4 - Only in Feb/May/Aug/Nov
5 - Only in Mar/Jun/Sep/Dec

AAFB - Andrews Air Force Base
BCS - Brandywine Communications Site
BFH - Brandywine Family Housing
DCS - Davidsonville Communications Site
DFH - Davidsonville Family Housing

Reviewed by: ______________________ Date: ________
Superintendent, ~~BES~~

Approved By: ______________________ Date: ________
Chief, BES

2.0 Reservoir Repair and Chlorination

- Talking Paper on Base Drinking Water Chlorine, 2/26/93
- Quality of Drinking Water, August 1992
- Evaluation of Drinking Water Disinfection, 12/14/92

Talking Paper
On

BASE DRINKING WATER CHLORINE

PROBLEM: Chlorine in base drinking water is being kept very high to prevent bacterial contamination, but the level is very irritating to base consumers.

BACKGROUND:

- Base suffered a two-month bacterial contamination of the drinking water system (Aug - Oct 91).

  -- To prevent escalation, chlorine levels were boosted.

  -- Source of bacteria was dirt entering cracks in base reservoir. Leaks were patched with cement and contamination was killed off. A chlorinator was installed at the inlet of the reservoir.

  -- Chlorine levels at the outlet of the reservoir are being maintained high (3.5 mg/l) indefinitely.

- Base water system also suffers from age and suboptimal design with numerous dead-ends. Chlorine levels drop quickly as water flows from the west side reservoir around to the east side of the base. This results in very high chlorine on the west side and low levels on the east side.

  -- This chlorine imbalance has caused many complaints from housing residents and hospital staff on the west side.

  -- The attached graph shows chlorine levels over the last twelve months at hospital buildings on the west and east side of the base. Chlorine levels are at or exceed levels considered maximum for swimming pools because of eye and mucous membrane irritation.

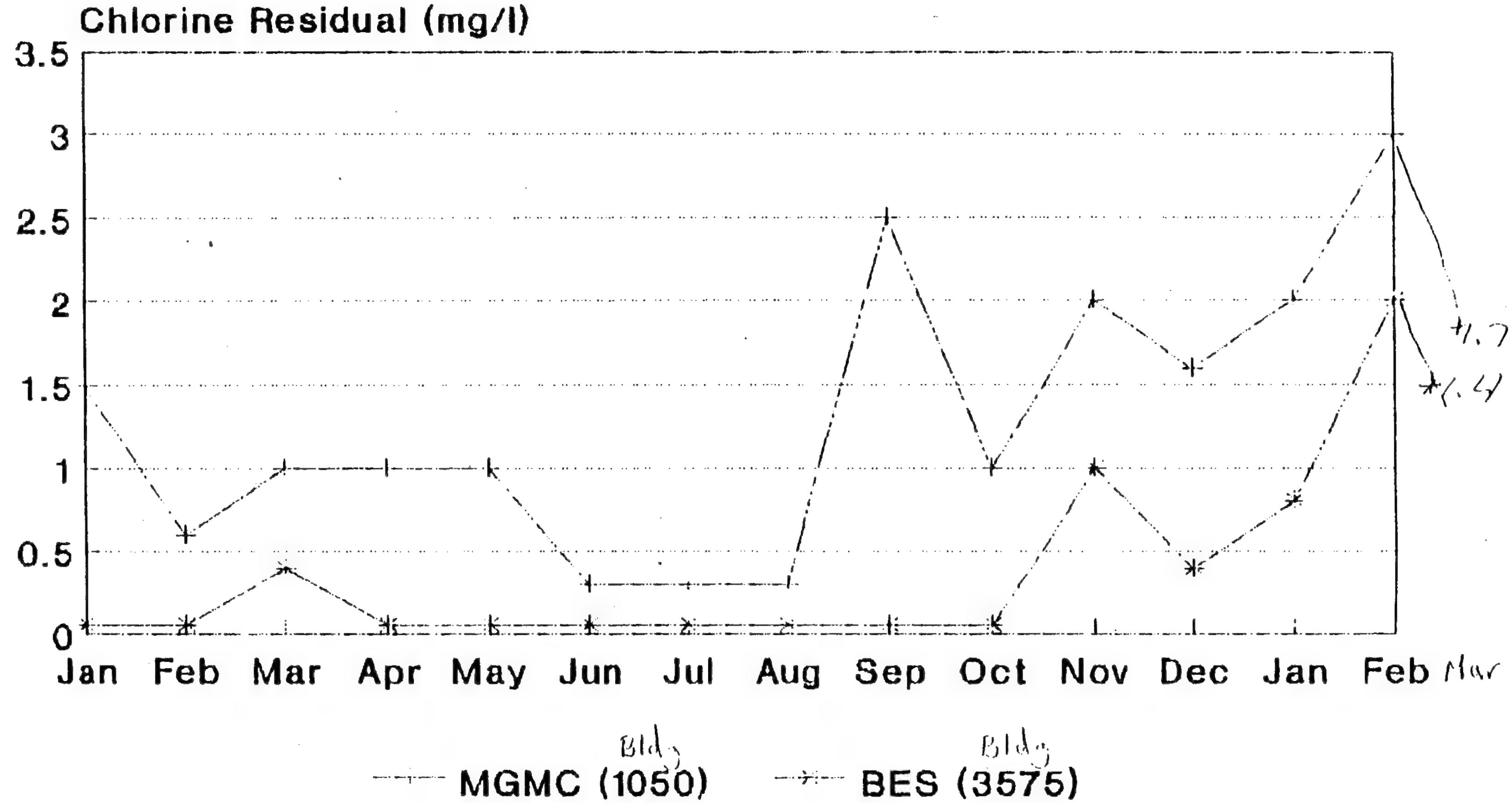
  -- This imbalance could be solved by installing chlorine boosters in the water distribution system.

Maj McGowan/MGMC/SGPB/26 Feb 92

Atch
Chlorine Graph

1991-92 Drinking Water Chlorine

AFR 161-44 requires 0.2 mg/l minimum



AFR 161-14 (pools) maximum is 2.0 mg/l !

DEPARTMENT OF THE AIR FORCE
MALCOLM GROW USAF MEDICAL CENTER (MAC)
ANDREWS AIR FORCE BASE DC 20331-5300

16 March 1992

REPLY TO ATTN OF: SG

SUBJECT: Quality of Drinking Water

TO: 89 AW/CC

1. It's been about six months since Civil Engineering resolved the drinking water crisis by patching the leaking reservoir and installing a chlorination point on the inlet side. Since then, our Bioenvironmental Engineering Services have recommended the outlet chlorination levels be maintained at an elevated level of 3.5 milligrams per liter (mg/l) to ward off future contaminations.

2. However, the age of the water distribution system still presents serious problems regarding chlorine levels and risks of future bacteriological contaminations. A "healthy" water system doesn't require a measurable chlorine residual on base if public water is supplied and the base system is adequate (the water supplied to the base is about 1.0 mg/l). If a higher risk of contamination exists, at least 0.2 mg/l must be held throughout the system, IAW AFR 161-44.

3. I believe the risks within our base system are significant enough to warrant the 0.2 mg/l minimum level. We've recommended the level of 3.5 mg/l leaving the reservoir not only because of the recent contamination, but also because chlorine levels, for years, have always dropped off to zero or trace levels on the west side of the base. Yet, even this is not a satisfactory situation (see attached SGPB talking paper). We have received a number of complaints about the chlorine within our medical center and from housing residents on the west side of the base. Some residents are boiling off the chlorine and others are purchasing bottled water. Definite medical effects from these chlorine levels are difficult to assess, but it is clear that people are not happy. Incidentally, 0.4 to 2.0 mg/l is the chlorine range required for swimming pools to fight bacteria while not so high as to irritate swimmers' eyes or mucous membranes.

4. We recommend you have your staff review this problem. Installing chlorine boosters on the east side of the base might be part of the best solution. We also recommend periodic checks of the interior of the reservoir for further cracks. MGMC staff is ready to help.

ROBERT W. POEL
Brigadier General, USAF, MC
Commander

Atch
MGMC/SGPB Talker, 26 Feb 92

DEPARTMENT OF THE AIR FORCE
MALCOLM GROW USAF MEDICAL CENTER (AMC)

14 Dec 92

FROM: SGPB

SUBJ: Evaluation of Drinking Water Disinfection

TO: SGP
SG
89 CES/CC
89 SPTG/CC
89 AW/CC
IN TURN

1. We've evaluated the base drinking water system's disinfection of bacteria in follow-up to MGMC/SG letter to 89 AW/CC, 16 Mar 92, (Atch 1). We have had no incidents of bacteria growth in the system since the reservoir contamination in 1991. Currently, Civil Engineering (CE) maintains system chlorine levels at about 1 milligram per liter on the west side of the base and this level tapers off to trace levels on the east side.

2. After consultation with CE, Armstrong Laboratory (Atch 2), and the Maryland Department of the Environment, we have concluded that the current disinfection procedures are adequate at this time but there are risks of bacterial contamination from the reservoir, from dead-end lines, and from distribution on the east side of the base.

a. Risk from the concrete reservoir cracking below grade with dirt infiltration has been addressed satisfactorily with the addition in early 1992 of a chlorine booster at the intake of the reservoir.

b. Risk from the dead-end lines building up sediment-harboring bacteria with low chlorine flow needs further control:

(1) CE should reinstitute at least a semiannual flushing program to reduce particulates and increase dead-end flows.

(2) Bioenvironmental Engineering Services (BES) and CE should monitor bacteria and chlorine at dead-ends and interior loops of the water distribution system.

(3) Construction should connect dead-end loops in residential areas back to main distribution lines.

c. Risk from low chlorine levels on the east side of the base will be reduced with the flushing program. We do not recommend building chlorine booster stations on the east side of the base at this time.

4. We will continue to work with CE to monitor and maintain the quality of base drinking water. This report will be briefed at the Environmental Protection Committee. If you have any questions please call us at 981-3380.

Lawrence A. McGowan

LAWRENCE A. MCGOWAN, Maj, USAF, BSC
Chief, Bioenvironmental Engineering

2 Atch
1. MGMC/SG Ltr, 16 Mar 92
2. MGMC/SGPB MFR, 12 Nov 92

3.0 Pre-Survey on Base Drinking Water

- Pre-Survey on Base Drinking Water, August 1992
- Reply to Pre-Survey on Base Drinking Water, 11/12/92

DEPARTMENT OF THE AIR FORCE
ARMSTRONG LABORATORY (AFMC)
BROOKS AIR FORCE BASE, TEXAS 78235-5000

FROM: AL/OEB
Brooks AFB TX 78235-5000

SUBJ: Consultative Letter, AL-CL-1992-0146 , Pre-Survey on Base Drinking Water, Andrews AFB MD

TO: Malcolm Grow USAF Medical Center/SGPB

1. In response to your 8 May 92 request for technical support from Armstrong Laboratory (AL), Maj Garland from the Bioenvironmental Engineering Division of the AL conducted a fact finding, pre-survey trip to Andrews AFB from 18-19 Aug 92. The purpose of the survey was to review the drinking water bacteriological program.

2. Persons Contacted:

Capt Jeff Cornell, Malcolm Grow USAF Medical Center(MGMC)/SGPB
Lt Nick MacConnell, MGMC/SGPB
Mr Mark Sabatteli, AAFB/DEVC
Mr Bernie Henniker, Water Treatment Plant
Ms Jane Johnson, Microbiologist Washington Aqueduct Division

3. Discussion:

a. The base's request asked for an assessment of the chlorine disinfection for drinking water on Andrews AFB. In the fall of 1991 the base experienced a period where bacteriological samples were positive in a number of locations in the distribution system. The base also experiences low chlorine levels in parts of the distribution system and has elevated chlorine levels at the base reservoir in an effort to obtain a chlorine residual.

b. The base receives its water from the Dalecarlia Water Treatment Plant which uses a surface water source. Dalecarlia records show total organic carbon (TOC) levels of 1.6 mg/1 in 90 and showed highest TOC levels during the Jun through Sep period. Coliform levels were also reported in the plant finished water in Jun and Aug 90. The pH of the finished water averaged 7.8 in 87, 8.0 in 88, and 8.1 in 89. More recent data on coliform and total organic carbon were not available (source Dalecarlia reports).

c. The Corrosion Analysis Report by Air Force Engineering and Services Center (AD-B142 866), Sep 86 indicates the water is slightly to moderately corrosive. It found no significant amount of scale or corrosion on any interior building piping. The

Langlier Saturation Index, Ryznar Index, and Aggressivity Index were reported at four sites as shown below:

Index	Golf Course	Bldg 1050	Bldg 3660	Bldg 1836
Langlier[1]	-0.04	-0.02	0.76	0.12
Ryznar[2]	7.91	7.82	7.12	7.66
Aggressive[3]	11.81	11.82	12.57	11.94

[1] If this index is equal to zero the water is in equilibrium and $CaCO_3$ is neither dissolved nor deposited.
[2] If the Ryznar index is greater than 7.0, then the water tends to dissolve solid $CaCO_3$.
[3] If the Aggressive index is 10-12 the water is moderately aggressive.

d. Finished water enters the base reservoir, which holds approximately 0.75 mg. Daily demand varies from 1.7 mgd to 2.5 mgd (Boyle Engineering Company May 87 Report, Existing Water System Study Andrews Air Force Base, project: AND 85-0877X3). The result is approximately 7 to 10 hours retention time in the reservoir. The reservoir was recently drained and repaired and has been identified as a source for coliform contamination, e.g., 22 Aug 91, 2 colonies/100 ml; 29 Aug 91, 15 colonies/100 ml, 31 Aug 91, 74 colonies/100 ml; 10 Sep 91, 32 colonies/100 ml (source SGPB water log).

e. The base applies gas chlorine at the outlet of the base reservoir, as high as 3 to 5 mg/l. After the Aug 91 coliform contamination, in the spring of 92, the base installed another gas chlorination system at the inlet of the reservoir to better maintain chlorine residual inside the reservoir. Water flows to two elevated storage tanks, one on the west side of the base and one on the east side of the base. The combined elevated storage is 0.75 mg. One tank is 0.5 mg and the second tank is 0.25 mg. Retention time in each tank should be a few hours under normal conditions.

f. The base distribution system is flawed in its design in that there are numerous dead ends in the water system. These dead ends frequently occur in housing areas where consumption might be low and sporadic. Many parts of the system are cast iron and up to 40 years old.

g. During the 91 episode, positive bacteriological results occurred in most cases where a chlorine residual was present, for example 23 out of 24 positives on 22-23 Aug 91 had a chlorine residual. There are also numerous cases in the water log documenting no chlorine residual and negative bacteriological results. Speciation of samples identified Enterobacter cloacae, Klebsiella pneumoniae, Vibrio damsela, and from a water truck,

Escherichia vulneris. Both *Klebsiella pneumoniae* and *Enterobacter cloacae* have been associated with biofilm growth in distribution systems and with growth in tubercles on cast iron pipes.

4. Conclusions:

a. There is clear evidence of an external source for the coliform contamination which occurred in 91, i.e., the base treatment reservoir. Bioenvironmental Engineering Services (BES) can monitor the conditions of the treatment reservoir more closely by adding a Heterotropic Plate Count (HPC) sample to their monthly sample strategy. A rise in the HPC, especially over 500, will signal a potential coliform problem. Furthermore, the treatment plant at Dalecarlia appears to be a sporadic source of coliform organisms into the system. Sampling of the influent water using media specially prepared for stressed microorganisms or high volume membrane filter samples would provide more information on whether this is a significant source. Samples for suspended solids and for assimilable organic carbon should be taken at the same time. These samples could be taken infrequently, perhaps quarterly to provide a baseline.

b. Conventional water treatment wisdom calls for a chlorine residual at the tap throughout a drinking water system. Chlorine controls taste and odor problems, especially when pH levels are below 7.5 and the primary form of chlorine is hypochlorous acid, HOCL. Hypochlorous acid is 80 to 100 times more effective a disinfectant than the hypochlorite ion OCl-, OCl- is the predominant species when the pH exceeds 7.5. PH levels have been steadily increasing in recent years, decreasing the effectiveness of the system's chlorine residual. The distribution system clearly has a biofilm, in fact most systems do. The existence of coliform bacteria in the presence of chlorine indicates coliform are associated either with a film that has sloughed of the system, or the coliform are associated with suspended particulate matter. There is no correlation at all between the presence of a chlorine residual and negative bacteriological results. Consequently, it would seem reasonable for the base to reduce their chlorine levels below 1.0 mg/l until some other data indicate a need to apply higher levels.

c. The sampling program that BES uses may be refined to make it more representative. Presently all the sample sites are in large facilities, or community-type facilities. Representative sites should also include homes on dead end loops of the distribution system. Sampling should also be expanded to include HPC samples near the effluent of the main base reservoir and each of the water towers. This sampling might be most appropriate on a monthly or quarterly basis. We would also recommend the BES conduct a study to evaluate retention times between the treatment plant and some of the customers on dead end loops. This study

can be done using fluoride. Maj Garland has provided several references by Geldreich on distribution system monitoring strategies for the base's use. As a minimum, the base should speciate all positive samples (from membrane filter samples) and some of the HPC samples. In the long term, Geldreich recommends 10 percent of any growth (on membrane filter samples) be speciated. An advantage of speciation is that it will enable the base to identify organisms typically associated with biofilm, versus other more harmful bacteria.

d. According to water plant personnel, there is no longer a base-wide flushing program. Flushing programs can be very advantageous when approached systematically. The most recent opinion in the professional water community is that flushing is beneficial overall. Considering the age and condition of the Andrews AFB system, we would strongly recommend the base consider re-implementing a semiannual flushing program that includes the entire base. The base should increase the chlorine dose during the flushing period. Maj Garland has provided the BES office a draft document, Implementation and Optimization of Distribution Flushing Programs, by Dr. Chadderton from Villanova. His recommendations minimize the impact flushing has on taste and odor and include tips on public involvement.

e. The base has considered several alternatives to prevent a coliform episode from occurring in the future. The first is the construction of chlorine booster stations in two portions of the base. Two problems come to mind with this action. First, the application of chlorine gas reduces the pH of the system and adds to corrosivity problems. The base will be sampling for lead and copper under the new Safe Drinking Water Act (SDWA) rules in the near future and one of the actions the base may need to take should it exceed the action limit would be to make the water less corrosive. The second problem is the lack of information on retention times in the dead ends of the system and the lack of any correlation between chlorine presence and bacteriological problems. We do not recommend chlorine boosters at this time.

f. An alternative that should be considered before the booster stations would be chloramination application at the reservoir. Chloramines are particularly effective at disinfecting coliform associated with biofilms and cast iron piping with tubercles. The chloramine residual time is also longer than chlorine applied as a gas.

g. If the BES expanded sampling program reveals continuing bacteriological problems at the system dead ends, the base should consider the benefits of connecting the dead ends into loops.

5. Recommendations:

a. Modify the drinking water surveillance program to include

more representative sites, HPC samples, high volume membrane filter bacteriological samples, and suspended solids.

b. Reduce chlorination dose levels to provide for less than 1.0 mg/l residual chlorine versus the present 3.0-5.0 mg/l.

c. In conjunction with the base civil engineers, evaluate retention time within the drinking water system.

d. Speciate all positive bacteriological samples for the next 6-12 months and speciate at least 10 percent of all samples in the long term.

e. Recommend that base civil engineers reinstitute a semiannual water distribution system flushing program.

f. Defer funding and construction of chlorine booster stations at this time.

g. Contact local water suppliers using chloramine disinfection for preliminary information on costs.

h. Consider connecting water distribution system dead ends based on the results of additional bacteriological sampling.

6. Please contact us if we can provide additional information of assistance.

EFM

EDWARD F. MAHER, Col, USAF, BSC
Chief, Bioenvironmental Engineering Division

cc: HQ AFMC/SGB
AFCESA/ENC
AFCEE/ESP

Memo For Record 12 Nov 92

SUBJ: Reply to AL/OEB Consultative Letter, AL-CL-1992-0146, Pre-Survey on Base Drinking Water, Andrews AFB MD

1. A study of the base drinking water system by AL/OEB resulted in (Atch) recommendations based on a coliform bacteria problem the base had in the fall of 1991. These recommendations are idealistic approaches to a given problem. Historically, Andrews has not had a coliform bacteria problem throughout the system.

2. I agree with most of the recommendations but at this time we do not have the capability to conduct the sampling recommended in the AL/OEB report nor do I feel we should. At the present time we sample 10 representative locations around the base. A change in the Maryland Total Coliform Rule - Sampling Site Plan Guidance of August 1992 dictates that we have to reevaluate our sampling plan. This analysis was started in September 1992 and should be completed by January 1993. So far it seems as though we will increase sampling points to include more dead ends and secondary loops as recommended in the AL/OEB letter. I definitely agree with a semiannual distribution flushing program which should be instituted ASAP.

3. Since the construction of the chlorinator at the inlet side of the reservoir, the chlorine levels have been maintained between 1.0 and 1.5 ppm chlorine. With a retention time of approximately 7 hours, this should adequately control any problems entering the system. Additionally, the source of the contamination in 1991 was directly attributed to cracks in the reservoir which were repaired. We have had no incidents of bacteria growth in the system since the repair.

4. At present, we conduct Membrane Filter analysis monthly throughout the system. When our new lab is completed, we will petition the State for approval to conduct the Colilert method of analysis. This method is quicker, easier, less expensive and just as accurate as the Membrane Filter method. With this method, we will probably sample at the discharge of the reservoir monthly. Until a problem within the system arises again, I do not recommend we sample as per the AL/OEB letter which includes HPC, high volume membrane filter bacteriological samples, or suspended solids as these tests will require additional equipment and resources that we presently do not have.

5. In the near future we will be sampling more selected points on the base IAW with the MDE requirements and AL/OEB recommendations for total coliform bacteria, hopefully using the Colilert method. I recommend the flushing program be instituted. I recommend the chlorine booster stations not be installed at this time. Highly recommend a program be started to connect the dead ends throughout the system. Other than that, I feel we have a handle on the problem.

6. As yet, we have not received the Lead and Copper results in total. The first half have been received and it looks as though only 1 in 20 have exceeded the EPA limits. This shows our system is not that bad off as yet. The rest of the results will tell and the second set will tell more.

7. I recommend 3 things at this time; reestablish sampling points to include dead ends and internal loops and sample with the colilert method when approved with any positives being check sampled with the membrane filter to facilitate speciation, and start a flushing program.

Richard N. MacConnell, 1Lt
MGMC/SGPB

Atch
AL/OES Ltr, 13 Oct 92

4.0 Coliform Contamination Reappearance

- March 1, 1993 Lab Results and Public Notice
- Talking Paper on Update of Bacterial Contamination of Base Drinking Water, 7/27/93

DEPARTMENT OF THE AIR FORCE
MALCOLM GROW USAF MEDICAL CENTER (AMC)

8 April 1993

FROM: SGPB

SUBJ: 016-0021 Coliform Contamination

TO: Maryland Department of the Environment
Water Supply Program
2500 Broening Highway
Baltimore, MD 21224

1. The attached bacteriological monitoring report form records a continuing coliform contamination of our base water supply since March 1, 1993 (see attachment 1). We reported this to Ms. Nancy Reilman of your office as soon as the first samples were confirmed. We have had no positives for fecal coliforms to date and base medical authorities have allowed consumption of water to continue.

2. Attachment 2 tabulates results of water sampling on base during March with locations, dates, and colony counts. Yesterday, Ms. Beverly-Long of your office authorized us to reduce sampling frequency from twice a week to once a week.

3. We believe the cause of the contamination is either dirt infiltration into a below-grade reservoir or else a biofilm throughout the system. Base civil engineering personnel, who operate the water system, are evaluating corrective actions [contact Major Greenough, (301) 981-7471]. We welcome your assistance.

4. Public notices have been issued to base consumers, as directed by Ms. Reilman. EPA-required language was included. The written notice was broadcast on a base cable network from 20 to 31 March. The same written notice was published in the base newspaper on 26 March (see attachment 3). There is no billing of water to base residents, but our weekly base newspaper is routinely delivered to every residence. Our next newspaper notice is planned for the 45-day point on 16 April, and will update the status of the contamination.

5. If you have any questions, please call us at (301) 981-3380.

LAWRENCE A. MCGOWAN, Maj, USAF, BSC
Chief, Bioenvironmental Engineering

3 Atchs
1. Report Form
2. Sampling Tabulation
3. Public Notice

cc: MGMC/SG/SGP
89 SPTG/CC/CE/CEO/CEV
89 AW/CC/CV/PA/JA

STATE OF MARYLAND
MDE-WATER SUPPLY PROGRAM
2500 BROENING HIGHWAY
BALTIMORE, MARYLAND 21224
BACTERIOLOGICAL MONITORING REPORT FORM

This report must be received by the 10th day of each succeeding month in which samples were collected. Results of invalidated samples are not to be included on this report form.

Name of Utility Andrews Air Force Base

Utility Identification Number 016-0021

Microbiological Examination Record for March 19 93

Sampler(s) Frank Walker Certification Number(s) 90-371

Name of Laboratory Bioenvironmental Engineering Water Laboratory, USAF Malcolm Grow Medical Center.

1) Population	7600
2) Total Number of Required Samples (based on population)	9
3)a) Total Number of Routine Samples Collected & Examined	73
b) Total Number of Routine Samples Total Coliform Positive	14
4)a) Total Number of Repeat Samples Collected & Examined	59
b) Total Number of Repeat Samples Total Coliform Positive	22
5) Percentage of Samples Total Coliform Positive $\frac{(3b + 4b)}{(3a + 4a)} \times 100$	27%
6)a) Total Number of Routine Samples Fecal Coliform Positive	0
b) Were any routine fecal coliform positives followed by repeat coliform positives?	Yes ___ No X
c) Total Number of Repeat Samples Fecal Coliform Positive	0
7) Original microbiological examination worksheets on file and available for inspection?	Yes X No ___

I do hereby affirm that this record contains no willful misrepresentations or falsifications and that this information given by me is true and complete to the best of my knowledge and belief.

Signed [signature] Date 07 April 1993

Title LAWRENCE A. McGOWAN, Maj, USAF, BSC
Chief, Bioenvironmental Engineer
Andrews AFB MD 20331 Telephone (301)981-3380

DENV 2578(Revised 10/90)

RECYCLED PAPER

Bacti Results MARCH 93

Location	1	2	4	5	6	7	9	12	17	18	23	25	30
4700 - Youth Ctr	0	0	0	38	0		0	0	0	0	0	0	0
4792-A - Spokane	5	1	1	8	10								
4085-4 - Edgebrook	3	0	1										
3575 - BEE Lab	0						0		0	0	0		0
3252 - 113 FW HQ	0					0	0		0	0			0
4793 - Spokane	0		0										
4087 - Edgebrook				0	36								
1836 - Reservoir A				57	0	16	0	0	0	2	0	0	0
1836 - Reservoir B					0	3	0	0	0	11	0	6	0
4613 - Laurel				99	0	0							
4744 - New Haven				0	1								
4753 - Fairway				22	0								
4763 - Cleveland				26	99	0							
4782 - Command					1	44							
4022 - Ashwood					0	0							
4079 - Yuma					3								
315 Topeka Ct.						0							
3780 - Louisiana						0			7				
1306 - Vandenberg						0							
1535 - Command Dr.						0							
1889 - NCO Club						0							
2021 - Bedford						0							
2137 - Atlanta						1							
4006-1 - Beech						0							
4272-2 - Elm						0							

Bacti Results MARCH 93

Location	1	2	4	5	6	7	9	12	17	18	23	25	30
4575 Child Dev Ctr						0	0	0		0	0	0	0
4671 - Spruce						0							
5136-A - Jerstad						0			0				
1050 - MGMC						42		0	20	1	0	0	6
Hangar 2						0	0		0	0	0	0	3
Hangar 8						0	0		0	0	4	10	6
3763 - Dining Hall							0			0			0

CHAMPUS

Civilian Hospitals

If you're admitted to a civilian hospital, chances are that the hospital participates in CHAMPUS; it's required by law to do so if it accepts Medicare patients.

But hospital-based individual professional providers of care (such as pathologists, radiologists and anesthesiologists) who help care for you in that hospital may not participate in CHAMPUS — even though the hospital does.

If possible, check with the hospital before being admitted, to see if those who will provide professional services to you will participate in CHAMPUS.

BASES

From Page 1

Operation Center West and the Drug Enforcement Agency Aviation Unit. The Southwest Air Defense Sector would remain at March in a cantonment area, pending the outcome of a North American Air Defense sector consolidation study. If the sector remains, it will transfer to the ANG.

All other activities at March will close, including family housing, the hospital, commissary and base exchange. The Air Force plans to dispose of all property not required within the revised boundaries of the Reserve base. Realignment recommendations are expected to be complete in 1996. The cost to realign March is estimated to be $134.8 million. The annual savings after realignment are estimated to be $46.9 million.

Realignment recommendations for McGuire will inactivate the 438th AW, with most of the C-141 aircraft transferring to Plattsburgh AFB, N.Y. Fourteen of the C-141 Starlifters will remain in place and transfer to the reserves. The 514th Airlift Wing (Reserve), 170th Air Refueling Group (ANG) and 108th ARW will remain and the base will convert to a Reserve base. With the realignment, the 913th AG, Willow Grove Air Force Reserve Station, Pa., will move to McGuire.

All other activities at McGuire will cease and facilities, including housing, the hospital (including Fort DixMcGuire Hospital), commissary and base exchange will close. The Air Force will dispose of all property outside the reduced base boundary and will consider joint use of the airfield. The cost of realignment is estimated to be $197.5 million, with the annual savings after realignment being $47.5 million.

Other AMC units affected by the announcement are the movement of KC-135 tankers from Ellsworth AFB, S.D., to McConnell AFB, Kan.; while at Barksdale AFB, La., the 458th Operations Group inactivates and all the unit's KC-10 tankers and the 98th ARG (Associate) would move to Plattsburgh AFB.

The command's KC-135 units at Griffiss AFB, N.Y., and Minot AFB, N.D., will move to Grand Forks AFB, N.D., as part of the DOD realignment action.

The Base Closure and Realignment Commision may make changes to the recommendations. Once the commission submits the recommendations to the president, he may either accept or reject the list. If he accepts the list, he must submit it to Congress and Congress

EVOLUTION

From Page 1

"We have for years had existing out there in the deployed commands fairly large enclaves of old Military Airlift Command assets. They served the purpose well, they supported the flow of aircraft as they moved around the theater. But we're changing the structure of airlift. Intratheater airlift has been assigned to the theater air commanders. So we've got to realign our en route structure, and quite frankly, in my view we'll end up bringing a great deal of that back to the states and make it deployable. Then we would have the assets available in the U.S. to go out and lay down our en route structure and have it ready to use no matter where we are tasked to go," Fogleman said.

"We're the only major command with worldwide flying responsibilities every day, so we have to have the infrastructure to perform that function," he said.

The examination and adjustment of the command has been ongoing in a year of almost constant activity, according to the general.

"If you think back on the last six months to the activities that have been going on while we've gone through this process you'll see that the command has not been allowed to take a break and do a lot of introspective examination. The command has been heavily tasked, with a series of natural disasters in the United States and humanitarian airlift throughout the world. All this has done is reinforce in my mind the importance of air mobility to the nation as we look to what is going to happen through the remainder of this decade and into the 21st century," he said.

The changes sweeping through AMC, the Ai Force and DOD as a whole are double edged one internally orchestrated and the other bein forced on the armed services by changing na tional priorities, according to Fogleman.

"We have little or no control over chang inflicted on us from the outside. But the secon kind of change, the 'good change' we are forcin upon ourselves is to better posture ourselves fo the rest of the decade and the 21st century."

The preliminary results of the Base Re alignment and Closure Commission is an exam ple of outside inflicted change which will alte the way the command performs its mission.

"People don't need to overreact to the find ings. They need to understand that these action are going to take a long time. They're not goin to be in place by the middle of next month There's time for people to plan their lives an adjust to these types of things, just as th command is doing. The condition of some o our bases is not good, it's not up to Air Forc standards." He noted those bases that aren readily fixable are likely to be on future closur or realignment lists.

Despite base closures, reduced resources an a smaller military, the priorities of the Clinto administration are a signal to AMC that it has crucial role to play in the future militar according to Fogleman.

"All indications are that air mobility, lift o all kinds — sealift, airlift, surface transportatio — all these things are going to remain ver important, central to what this administration i trying to accomplish. Our challenge as a com mand is to posture ourselves to take care of ou people and build the infrastructure that allow us to provide mobility for the country and th world. This will not be an easy chore. We nee to work hard at making intelligent decisions o how we restructure the force," the general said.

PUBLIC NOTICE

Commander releases update on status of base drinking water

As most of you know, our base drinking water is continually monitored to ensure its purity. The base water system is checked twice a week by the 89th Medical Group bioenvironmental engineers. Since March 1, test results indicated a sporadic, low concentration of coliform bacteria.

The slight increase in this bacteria has not affected the safety of our water supply. At these extremely low bacteria concentrations, a person's natural resistance is more than adequate as it combats germs everyday. The Malcolm Grow USAF Medical Center has increased water sampling and is working with base civil engineers to resolve the problem.

The wing commander, along with MGMC will continue to monitor the situation closel We will notify you immediately if the situatio changes. The EPA health advisory at the bo tom of the page is for informational purpose should our problem worsen.

Again, our base situation does not warrar concern. MGMC and Civil Engineering ar taking maximum efforts to resolve this prob lem. If you have any further questions, you ma contact Lt. Col. Temple Black, chief of Publi Affairs at (301)981-4424.

EPA Health Advisory

The U.S. Environmental Protection Agency sets drinking water standards and has determined that the presence of total coliforms is a possible health concern. Total coliforms are common in the environment and are generally not harmful themselves. The presence of these bacteria in drinking water, however, generally is a result of a problem with the water treatment or the pipes which distribute the water and indicates that the water may be contaminated with organisms that can cause disease.

Disease symptoms may include diarrhea, cramps, nausea, possibly jaundice and any associated headaches and fatigue. These symptoms, however, are not just associated with disease causing organisms in drinking water, but also may be caused by a number of factors other than your drinking water.

EPA has set an enforceable drinking water standard for total coliforms to reduce the risk of these adverse health effects. Under this standard, no more than 5 percent of the samples collected during a month can contain these bacteria, except that systems collecting fewer than 40 samples/month that have one total coliform-positive sample per month are not violating the standard. Drinking water which meets this standard is usually not associated with a health risk from disease-causing bacteria and should be considered safe.

Talking Paper
On

UPDATE ON BACTERIAL CONTAMINATION OF BASE DRINKING WATER

PROBLEM: Coliform bacteria, which disappeared in early July after disconnecting the reservoir, has now reappeared in the Andrews drinking water system since July 15. This gives strong evidence that the water distribution system is contaminated with a biofilm.

DEFINITION: "Biofilm" refers to a condition of a water system in which microorganisms are thriving in accumulations of sediment and mineral deposits in water pipes.

BACKGROUND: This coliform contamination originally appeared in Mar 93, and we have found coliform bacteria sporadically and randomly all around the base ever since.

On 22 Jun, Civil Engineering switched the base water supply from the District to the County in order to bypass the reservoir, which was suspected to be the source of the bacterial contamination. This concrete reservoir is below grade and has cracks that allow soil with bacteria to infiltrate into the system.

RECENT STATUS: For three weeks after the reservoir was bypassed, bacterial water samples were clean, and we were about to conclude the reservoir was the problem. A public notice in the Capital Flyer, 16 Jul, informed the base that we hadn't detected bacteria for a couple weeks with the reservoir bypassed.

However, water samples on 15, 20 and 23 July all grew coliform bacteria. No fecal bacteria were found, so there isn't an immediate health hazard. Chlorine disinfectant levels of the County's water are strong at 1.5 mg/L.

These facts give clear evidence that our distribution system is contaminated with a biofilm. Chlorine is generally ineffective against biofilm bacteria. However, literature indicates chloramination disinfection is quite effective against biofilm and the base treatment plant could probably change from chlorine to chloramination with minor cost and effort. We have already identified some public water systems in Maryland and Virginia that are now using chloramination. The initial conversion to chloramination may require superchlorination of the entire base system for part of a day.

The state of Maryland's Water Supply Program has been informed via telecon of the reappearance of bacteria, as required. Three weeks earlier, when informed of our plan to switch water supplies, the state said they would send the base a Notice of Violation (NOV) if this didn't correct the problem. We have complied with all state requirements for public notices since the violation technically began in March.

RECOMMENDATIONS:

- Civil Engineering obtain consultation from AF Civil Engineering Service Agency or contractor with specific technical expertise on biofilms so as to resolve the following issues:

-- How to best eliminate the biofilm from our water distribution system.

-- Which water supplier - the District or the County - can best supply our water requirements, which include (besides cost and fire fighting) continuous disinfection against biofilm contamination.

-- Is it cost effective to repair the reservoir? There is a possibility that the reservoir's soil infiltration "seeded" our distribution system with bacteria that's now developed into a biofilm.

- If there is a delay of several weeks before further corrective actions are undertaken by Civil Engineering, we recommend bringing the reservoir back on line so the water plant can raise chlorine levels to 3 to 5 mg/L. This will help keep the biofilm under control temporarily, and was used effectively during a similar contamination on Andrews two years ago.

- The reservoir is still about three quarters full of water but has sat unused for three weeks. Recommend the reservoir water be chlorinated to 5 mg/L and then be pumped into the distribution system. If the reservoir is eventually going to be returned to service, we recommend it first be inspected for cracks and repaired to prevent further infiltration of soil.

- As long as the base remains on the County supply, the base's two water towers are not used. If the County continues to supply our water, we recommend the towers be periodically valved on and off the system to keep them fresh.

Maj McGowan
89 MG/SGPB
27 Jul 93

OK. 27 July 93

Please give copy to [illegible] Mitchell BSAP today.

Copy to Col Moore.

Microbiological Sampling Results of Andrews AFB Drinking Water

	Feb 1993					Mar													Apr			
	03	10	17	24	25	01	02	04	05	06	07	09	12	17	18	23	25	30	08	13	20	27
# Samples	02	02	03	03	03	06	03	04	08	12	22	09	05	10	10	08	07	10	12	12	11	12
# Coliform Positive Samples	00	00	00	00	00	02	01	02	06	06	06	00	00	02	03	01	02	03	00	00	01	03

	May				Jun					Jul				
	05	12	19	26	02	09	16	24	30	07	14	15	20	23
# Samples	03	11	10	10	12	12	12	11	10	10	11	10	10	10
# Coliform Positive Samples	00	00	01	00	02	00	01	01	00	00	00	06	02	01

5.0 Laboratory Data and Sampling Results

- EA Laboratory Data Report—Trihalomethanes, 11/11/93
- Gascoyne Total Coliform Results, 11/16/93
- AAFB/EA Side-by-Side Total Coliform Results, 11/30/93 (AAFB Results)
- Martel Total Coliform Results, 11/30/93
- AAFB/EA Side-by-Side Chlorine Residual Results, 11/30/93 (AAFB Results)
- AAFB Total Coliform Sampling Results (EA Modified), 12/1/93-12/20/93
- AAFB Total Coliform Sampling Results, January 1994
- MDHMH Reports of an Interim Survey of Bioenvironmental Engineering Water Laboratory, 6/29/93 and 9/30/93
- Martel Lab and Sampling Audit, 12/14/93
- Martel Telecon, 2/7/94

- EA Laboratory Data Report—Trihalomethanes, 11/11/93

LABORATORY DATA REPORT

Prepared for:

EA Engineering, Science, and Technology
Andrews AFB

Prepared by:

EA Laboratories
19 Loveton Circle
Sparks, Maryland 21152

November 1993

EA Laboratories
ANALYTICAL NARRATIVE

Client: **EA Eng., Sci., and Tech., Inc.**
Site: **Andrews AFB**
Project number: **12206.51**

Laboratory Project Manager: **R. Thomas Randall**
EA Laboratories Report: **931671**
Date: **22 November 1993**

This report contains the results of the analyses of four water samples collected on 11 November 1993 in support of the above referenced project. The samples arrived handcarried and intact at EA Laboratories on 11 November 1993. Upon receipt at the laboratory the samples were inspected, compared with the chain of custody record, logged into the laboratory computer system with assigned laboratory accession numbers and released for analysis. Trihalomethanes were determined according to U.S. EPA Method 524.2.

CLIENT SAMPLE NAME	EA LAB NUMBER
AT3-1057 CONTROL	12686
AT3-1057 4.11PPM TRC	12687
AT3-1057 6.23PPM TRC	12688
AT3-1057 9.39PPM TRC	12689

Results are reported in the summary forms which follow.

Quality Control

This section summarizes the general quality control activities performed by the laboratory which relate to laboratory method performance, sample matrix effects, and field quality control samples. Quality control samples specified by the project and in the analytical methods are analyzed and reported as required, and the data are validated by analyst, staff, and supervisor review.

Laboratory method performance: All quality control criteria for method performance must be met for data to be reported. These criteria generally apply to instrument tune, calibration, method blanks, and Laboratory Control Samples (LCS).

Sample matrix effects: Quality control samples are analyzed to determine any measurement bias due to the sample, and may include matrix spikes (MS), matrix spike duplicates (MSD), and laboratory duplicates (D). If criteria are not met, matrix interferences are confirmed either by reanalysis or by inspection of the LCS results to verify that laboratory method performance is in control. Data are reported with appropriate qualifiers or discussion.

Field quality control samples: Field duplicates, trip blanks, and rinsate blanks are used to

EA Laboratories
ANALYTICAL NARRATIVE

Client: **EA Eng., Sci., and Tech., Inc.**
Site: **Andrews AFB**
Project number: **12206.51**

Laboratory Project Manager: **R. Thomas Randall**
EA Laboratories Report: **931671**
Date: **22 November 1993**

---

evaluate information on field quality control activities. Unless specific laboratory performance criteria and corrective actions are identified in the project requirements, the laboratory treats these as any other field sample, and results are reported after routine laboratory data validation.

Certification of Results
The Laboratory certifies that this report meets the project requirements for analytical data as stated in the Analytical Task Order (ATO) and the chain of custody. In addition, the Laboratory certifies that the data as reported meets the Data Quality Objectives for precision, accuracy and completeness specified for this project or as stated in EA Laboratories Quality Assurance program for other than the conditions detailed above. Release of the data contained in this report has been authorized by the appropriate Laboratory Manager or designee as verified by the following signature.

Theodore W. Dolzine, Organics Manager

22 November 1993

INDIVIDUAL DATA SHEETS
Volatiles - 524.2

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO:

AT3-1057 CON

Lab Name: EA LABS Contract: 12206.95

Lab Code: EAENG Case No: SAS No.: ______ SDG No:

Matrix: (soil/water) WATER Lab Sample ID: 12686

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: AQ528

Level: (low/med) LOW Date Received: 11/11/93

% Moisture: not dec. ______ Date Analyzed: 11/18/93

GC Column: RTX502.2 ID: .53 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
75-71-8	Dichlorodifluoromethane	1	U
75-43-4	Dichlorofluoromethane	1	U
67-66-3	Chloroform	37	
75-27-4	Bromodichloromethane	11	
124-48-1	Dibromochloromethane	22	
75-25-2	Bromoform	1	U

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO:

AT3-1057 4.1

Lab Name: EA LABS Contract: 12206.95

Lab Code: EAENG Case No: SAS No.: ______ SDG No:

Matrix: (soil/water) WATER Lab Sample ID: 12687

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: AQ529

Level: (low/med) LOW Date Received: 11/11/93

% Moisture: not dec. ______ Date Analyzed: 11/18/93

GC Column: RTX502.2 ID: .53 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume:_____ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
75-71-8	Dichlorodifluoromethane	1	U
75-43-4	Dichlorofluoromethane	1	U
67-66-3	Chloroform	32	
75-27-4	Bromodichloromethane	10	
124-48-1	Dibromochloromethane	2	
75-25-2	Bromoform	1	U

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO:

AT3-1057 6.2

Lab Name: EA LABS   Contract: 12206.95

Lab Code: EAENG   Case No: SAS No.: ______   SDG No:

Matrix: (soil/water) WATER   Lab Sample ID: 12688

Sample wt/vol: 5.0 (g/mL) ML   Lab File ID: AQ530

Level: (low/med) LOW   Date Received: 11/11/93

% Moisture: not dec. ______   Date Analyzed: 11/18/93

GC Column: RTX502.2 ID: .53 (mm)   Dilution Factor: 1.0

Soil Extract Volume: _____ (uL)   Soil Aliquot Volume: _____ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
75-71-8	Dichlorodifluoromethane	1	U
75-43-4	Dichlorofluoromethane	1	U
67-66-3	Chloroform	32	
75-27-4	Bromodichloromethane	9	
124-48-1	Dibromochloromethane	2	
75-25-2	Bromoform	1	U

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO:

AT3-1057 9.3

Lab Name: EA LABS Contract: 12206.95

Lab Code: EAENG Case No: SAS No.: ______ SDG No:

Matrix: (soil/water) WATER Lab Sample ID: 12689

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: AQ531

Level: (low/med) LOW Date Received: 11/11/93

% Moisture: not dec. ______ Date Analyzed: 11/18/93

GC Column: RTX502.2 ID: .53 (mm) Dilution Factor: 1.0

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (u

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
75-71-8	Dichlorodifluoromethane	1	U
75-43-4	Dichlorofluoromethane	1	U
67-66-3	Chloroform	31	
75-27-4	Bromodichloromethane	9	
124-48-1	Dibromochloromethane	2	
75-25-2	Bromoform	1	U

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO:

VBLK1

Lab Name: EA LABS   Contract: 12206.95

Lab Code: EAENG   Case No: SAS No.: ______   SDG No:

Matrix: (soil/water) WATER   Lab Sample ID: AQ526

Sample wt/vol: 5.0 (g/mL) ML   Lab File ID: AQ526

Level: (low/med) LOW   Date Received: / /

% Moisture: not dec. ______   Date Analyzed: 11/18/93

GC Column: RTX502.2 ID: .53 (mm)   Dilution Factor: 1.0

Soil Extract Volume: _____ (uL)   Soil Aliquot Volume:_____ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) ug/L	Q
75-71-8	Dichlorodifluoromethane	1	U
75-43-4	Dichlorofluoromethane	1	U
67-66-3	Chloroform	1	U
75-27-4	Bromodichloromethane	1	U
124-48-1	Dibromochloromethane	1	U
75-25-2	Bromoform	1	U

Chain of Custody Record

EA Laboratories
19 Loveton Circle
Sparks, MD 21152
(410) 771-4920
Fax (410) 771-4407

Company Name: [illegible]

Project No.: [illegible]

Project Manager or Contact: [illegible]

Phone:

Project Name: [illegible]

Sample Storage Location: GCMS

ATO Number: 3827

Page of

Job ID: 1483

Report/Deliverables: EA STD Rpt
Verbal 11/18
Hardcopy 11/25/93

Parameters/Method Numbers for Analysis*: 524.2

Date	Time	Water	Soil	Sample Identification 19 Characters	No. of Containers	524.2	EA Labs Accession Number	Remarks
[illegible]	[illegible]	x		[illegible]	3	X	12686	LPM:
↓	↓	↓		[illegible]	2	X	12687	
				[illegible]	2	X	12688	
				[illegible]	2	X	12689	
								L4085

Sampled by (Signature): [illegible] | Date/Time: [illegible]

Relinquished by: (Signature): [illegible] | Date/Time: [illegible]

Received by: (Signature): Archer | Date/Time: 11/11/93 1100

Relinquished by (Signature): | Date/Time:

Received by (Signature): | Date/Time:

Airbill Number:

Sample Shipped by (Circle): Fed Ex Puro UPS Hand Carried Other

Cooler Temp: NA C pH: ☐ Yes ☒ No Comments: VOA Hand Carried

Custody Seals Intact ☐ Yes ☒ No

NOTE: Please indicate method number for analyses requested. This will help clarify any questions with laboratory techniques.

WHITE - EA Laboratories YELLOW - EA Laboratories PINK - Project Manager

Shaded Areas for Lab Use Only

- Gascoyne Total Coliform Results, 11/16/93

Gascoyne Laboratories, Inc.

Baltimore, MD 21224-6697

(410) 633-1800
(800) GAS-COYN
FAX NO.
(410) 633-5443

REPORT OF ANALYSIS

Report No. 93-11-427 Report Date: November 23, 1993

Report To: EA Engineering, Science & Tech. Page: 1 of 1

Sample I.D. Submitted Drinking Water: Grab, Andrews AFB, dated 11/17/93

	Total Coliform
4575 (0945)	Negative
4003 (1340), (4)	Positive
1535 (1423)	Negative
3575 (1353)	Negative
1889 (1410)	Negative
4014 (1005)	Negative
2137 (1325)	Negative
4753 (1045)	Negative
4027 (1015)	Negative
4272 (1025)	Negative
4079 (1035)	Negative
2086 (1317)	Negative

Notes: (1) Results based on 100 ml.

(2) Method(s): MMO-MUG (Colilert), EPA 570/9-90-008A October 1991;
Analyst(s): RAH;
Date/Time Test Started: 11/17/93 (1700)
Date/Time Test Completed: 11/18/93 (1700)

(3) Samples have been checked for the presence of sodium thiosulfate using iodine and were found to be positive.

(4) Fecal Coliform - Negative.

William L. Lock
Laboratory Director

Please see reverse side for explanation of terms and other information.

Gascoyne Laboratories, Inc.

Baltimore, MD 21224-6697

(410) 633-1800
(800) GAS-COYN
FAX NO.
(410) 633-5443

REPORT OF ANALYSIS

Report No. 93-11-421 Report Date: November 23, 1993

Report To: EA Engineering, Science & Tech. Page: 1 of 1

Sample I.D. Submitted Drinking Water: Grab, Andrews AFB, dated 11/16/93

	Total Coliform
5136 Jerstadt (1250)	Negative
Hangar #8 (1010)	Negative
113th HQ (1052)	Negative
4782 Command Drive (1320)	Negative
Youth Center (1311)	Negative
Dining Hall 3763 (1037)	Negative
Hanger #2 (1022)	Negative
3780-5 Louisiana (1042)	Negative
5016 AF-1 (1351)	Negative
4638 Poplar Ct. (1300)	Negative
MGMC 1050 (1000)	Negative

Notes: (1) Results based on 100 ml.

(2) Method(s): MMO-MUG (Colilert), EPA 570/9-90-008A October 1991;
Analyst(s): RAH;
Date/Time Test Started: 11/17/93 (0845)
Date/Time Test Completed: 11/18/93 (0845)

(3) Samples have been checked for the presence of sodium thiosulfate using iodine and were found to be positive.

William L. Lock
Laboratory Director

- AAFB/EA Side-by-Side Total Coliform Results, 11/30/93
  (AAFB Results)

BIOENVIRONMENTAL ENGINEERING SERVICES
89th MEDICAL GROUP/SGPB
1535 COMMAND DRIVE SUITE C-108
ANDREWS AFB MD 20331-7002
FAX: (301) 981-9657 / DSN 858-9657
VOICE: (301) 981-3380 / DSN 858-3380

FAX TRANSMISSION

FROM: James F Percy

TO: Doug Piper

SUBJECT: Side By Side

MESSAGE:

NUMBER OF PAGES (INCLUDING THIS COVER):

EA AND ANDREWS AFB SIDE BY SIDE
COLLECTED 30 NOV 93

	LOCATION	RESULTS
1.	113 TFW	NEGATIVE
2.	MGMC	NEGATIVE
3.	HANGER 2	NEGATIVE
4.	HANGER 8	POSITIVE
5.	3780 LOUISIANA	NEGATIVE
6.	YOUTH CENTER	NEGATIVE
7.	4782 COMMAND DRIVE	NEGATIVE
8.	4638 POPLAR CT	NEGATIVE
9.	5136 JERSTAD	NEGATIVE
10.	4079	NEGATIVE
11.	4027	POSITIVE
12.	4763 FAIRWAY	NEGATIVE
13.	4272 WILMINGTON	NEGATIVE
14.	CHILD DEVELOPMENT CENTER	NEGATIVE
15.	4014 BEECH	POSITIVE
16.	HANGER 17	POSITIVE
17.	1535	NEGATIVE
18.	1889 NCO CLUB	NEGATIVE
19.	3575	NEGATIVE
20.	2137	NEGATIVE
21.	2086-A	NEGATIVE

If there are any questions, please call SSgt Percy or Amn Kinser of the Bioenvironmental Engineering Office at (301)981-3380.

James F. Percy

James F. Percy, SSgt, USAF

- Martel Total Coliform Results, 11/30/93

FAX FROM MARTEL

1025 Cromwell Bridge Road • Baltimore, Maryland 21286 • Telephone (410) 825-7790 • Facsimile (410) 821-1054
250 Meadowfern, Suite 102 • Houston, Texas 77067 • Telephone (713) 872-9100 • Facsimile (713) 872-7916
1438 Sangamon Avenue • Springfield, Illinois 62702 • Telephone (217) 522-0009 • Facsimile (217) 522-2119

TO: Doug Piper

ORGANIZATION: EA Labs

RECIPIENT'S FAX NO.: (410)771-4204

FROM: Jeannine M. McCrumb JM

DATE: December 2, 1993

NO. OF PAGES: (including cover page) 4

RE: Drinking water analyses

Please call if you have any questions about these results.

Page No. 1
12/02/93

This is an UPDATE

Control No.	Test Code	Result	units
** Company EA			
* Sample Id 1DW. MGMC - Bldg #1050 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.8	mg/l
* Sample Id 2DW. 5136 Jerstad 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	1.1	mg/l
* Sample Id 3DW. 2137 Atlanta 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	1.4	mg/l
* Sample Id 4DW. 2086 Harvard 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	1.4	mg/l
* Sample Id 5DW. 4753 Fairway 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.13	mg/l
* Sample Id 6DW. 4782 Command 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.04	mg/l
* Sample Id 7DW. Youth Center 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.17	mg/l
* Sample Id 8DW. 4079 Yuma 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.1	mg/l
* Sample Id 9DW. 4638 Poplar 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml

Page No. 2
12/02/93

This is an UPDATE

Control No.	Test Code	Result	units
29126	CLTOTF	1.1	mg/l
* Sample Id 10DW. 4027 Ashwood 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.15	mg/l
* Sample Id 11DW. 4014 Beech 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.28	mg/l
* Sample Id 12DW. 4272 Wilmington 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.25	mg/l
* Sample Id 13DW. 4575 CDC 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.4	mg/l
* Sample Id 14DW. Bldg #1535 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	1.2	mg/l
* Sample Id 15DW. Bldg #3004 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.75	mg/l
* Sample Id 16DW. 113 HQ 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	0.03	mg/l
* Sample Id 17DW. Bldg #3575 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	<0.02	mg/l
* Sample Id 18DW. 3780 Louisiana 11/30/93			
29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml

Page No. 3
12/02/93

This is an UPDATE

Control No.	Test Code	Result	units
29126	CLTOTF	1.2	mg/l

* Sample Id 19DW. NCO Club 11/30/93

29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	1.5	mg/l

* Sample Id 20DW. Hangar 2 11/30/93

29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	1.4	mg/l

* Sample Id 21DW. Hangar 8 11/30/93

29126	COLILER	NEG	
29126	MFCOLI	<1	org/100ml
29126	CLTOTF	1.2	mg/l

Martel
1025 Cromwell Bridge Road
Baltimore, MD 21286
(410) 825-7790
(410) 821-1054 [Fax]

Certificate of Laboratory Analysis

Martel Lab Number: FT000194
Log Identification: FT-29126

RECEIVED
DEC 7 1993
EA Engineering, Science, and Technology
Sparks, MD

EA Engineering, Science & Technology, Inc
P.O. Box 75031
Baltimore, Maryland 21275
ATTENTION: Doug Piper

Sampling by Martel.

CLIENT IDENTIFICATION: EA

December 3, 1993

ANALYTICAL PARAMETER	METHOD	RESULT	UNITS
LOG IDENTIFICATION: FT-29126			
DATE RECEIVED: 11/30/93			
SAMPLE ID: 1DW. MGMC - Bldg #1050			
SAMPLING DATE: 11/30/93 TIME: 09:50			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.8	mg/l
SAMPLE ID: 2DW. 5136 Jerstad			
SAMPLING DATE: 11/30/93 TIME: 10:00			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	1.1	mg/l
SAMPLE ID: 3DW. 2137 Atlanta			
SAMPLING DATE: 11/30/93 TIME: 10:10			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	1.4	mg/l

Martel
1025 Cromwell Bridge Road
Baltimore, MD 21286
(410) 825-7790
(410) 821-1054 [Fax]

Certificate of Laboratory Analysis

CLIENT IDENTIFICATION: EA
LOG IDENTIFICATION: FT-29126
December 3, 1993

ANALYTICAL PARAMETER	METHOD	RESULT	UNITS
SAMPLE ID: 4DW. 2086 Harvard			
SAMPLING DATE: 11/30/93 TIME: 10:20			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	1.4	mg/l
SAMPLE ID: 5DW. 4753 Fairway			
SAMPLING DATE: 11/30/93 TIME: 10:30			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.13	mg/l
SAMPLE ID: 6DW. 4782 Command			
SAMPLING DATE: 11/30/93 TIME: 10:40			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.04	mg/l
SAMPLE ID: 7DW. Youth Center			
SAMPLING DATE: 11/30/93 TIME: 10:50			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.17	mg/l

Martel
1025 Cromwell Bridge Road
Baltimore, MD 21286
(410) 825-7790
(410) 821-1054 [Fax]

Certificate of Laboratory Analysis

CLIENT IDENTIFICATION: EA
LOG IDENTIFICATION: FT-29126
December 3, 1993

ANALYTICAL PARAMETER	METHOD	RESULT	UNITS
SAMPLE ID: 8DW. 4079 Yuma			
SAMPLING DATE: 11/30/93 TIME: 11:00			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.1	mg/l
SAMPLE ID: 9DW. 4638 Poplar			
SAMPLING DATE: 11/30/93 TIME: 11:05			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	1.1	mg/l
SAMPLE ID: 10DW. 4027 Ashwood			
SAMPLING DATE: 11/30/93 TIME: 11:15			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.15	mg/l
SAMPLE ID: 11DW. 4014 Beech			
SAMPLING DATE: 11/30/93 TIME: 11:25			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.28	mg/l

Martel
1025 Cromwell Bridge Road
Baltimore, MD 21286
(410) 825-7790
(410) 821-1054 [Fax]

Certificate of Laboratory Analysis

CLIENT IDENTIFICATION: EA
LOG IDENTIFICATION: FT-29126
December 3, 1993

ANALYTICAL PARAMETER	METHOD	RESULT	UNITS
SAMPLE ID: 12DW. 4272 Wilmington			
SAMPLING DATE: 11/30/93 TIME: 11:35			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.25	mg/l
SAMPLE ID: 13DW. 4575 CDC			
SAMPLING DATE: 11/30/93 TIME: 11:40			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.4	mg/l
SAMPLE ID: 14DW. Bldg #1535			
SAMPLING DATE: 11/30/93 TIME: 11:55			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	1.2	mg/l
SAMPLE ID: 15DW. Bldg #3004			
SAMPLING DATE: 11/30/93 TIME: 12:40			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.75	mg/l

Martel
1025 Cromwell Bridge Road
Baltimore, MD 21286
(410) 825-7790
(410) 821-1054 [Fax]

Certificate of Laboratory Analysis

CLIENT IDENTIFICATION: EA
LOG IDENTIFICATION: FT-29126
December 3, 1993

ANALYTICAL PARAMETER	METHOD	RESULT	UNITS
SAMPLE ID: 16DW. 113 HQ			
SAMPLING DATE: 11/30/93 TIME: 12:55			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	0.03	mg/l
SAMPLE ID: 17DW. Bldg #3575			
SAMPLING DATE: 11/30/93 TIME: 13:05			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	<0.02	mg/l
SAMPLE ID: 18DW. 3780 Louisiana			
SAMPLING DATE: 11/30/93 TIME: 13:15			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	1.2	mg/l
SAMPLE ID: 19DW. NCO Club			
SAMPLING DATE: 11/30/93 TIME: 13:25			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	1.5	mg/l

Martel
1025 Cromwell Bridge Road
Baltimore, MD 21286
(410) 825-7790
(410) 821-1054 [Fax]

Certificate of Laboratory Analysis

CLIENT IDENTIFICATION: EA
LOG IDENTIFICATION: FT-29126
December 3, 1993

ANALYTICAL PARAMETER	METHOD	RESULT	UNITS
SAMPLE ID: 20DW. Hangar 2			
SAMPLING DATE: 11/30/93 TIME: 13:40			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	1.4	mg/l
SAMPLE ID: 21DW. Hangar 8			
SAMPLING DATE: 11/30/93 TIME: 13:55			
Total Coliform Bacteria by Colilert	EPA	NEG	
Total Coliforms by Membrane Filtration		<1	org/100ml
Chlorine (total residual)	EPA 330.5	1.2	mg/l

Jeannine M. McCumbs
LABORATORY APPROVAL

12/03/93
DATE

All procedures used are in accordance with the following methods: "Methods of Chemical Analysis of Water and Wastewater", EPA 600/4-79/020, U.S. EPA, Cincinnati, Revised March 1983. "Standard Methods for the Examination of Water and Wastewater", 16th Edition, 1985.

- AAFB/EA Side-by-Side Chlorine Residual Results, 11/30/93 (AAFB Results)

BIOENVIRONMENTAL ENGINEERING SERVICES
89th MEDICAL GROUP/SGPB
1535 COMMAND DRIVE SUITE C-108
ANDREWS AFB MD 20331-7002
FAX: (301) 981-9657 / DSN 858-9657
VOICE: (301) 981-3380 / DSN 858-3380

FAX TRANSMISSION

FROM: James Percy

TO: Chris Gould

SUBJECT: Chlorine Residual

MESSAGE: Here is what you requested. I added some things you may need later

NUMBER OF PAGES (INCLUDING THIS COVER): 2

18 Feburary 1994

Listed below are the chlorine residual and site locations you requested if you have any question you can call me at (301)981-3380.

	LOCATION	CHLORINE	PH	COLILERT
1.	113 TFW HQ	0	7.4	Absent
2.	Hospital MGMC	.8	7.4	Absent
3.	Hangar 2	1.0	7.4	Absent
4.	Hangar 8	1.0	7.4	Presence
5.	3780 Louisiana	1.0	7.6	Absent
6.	Youth Center	0	7.2	Absent
7.	4782 Command Dr.	0	7.6	Absent
8.	4638 Poplar Ct.	.8	7.4	Absent
9.	5136 Jerstad	.8	7.4	Absent
10.	4079	0	7.4	Absent
11.	4027	0	7.6	Presence
12.	4753 Fairway	.1	7.6	Absent
13.	4272 Wilmington	.8	7.6	Absent
14.	Child Dev Center	.4	7.6	Absent
15.	4014 Beech	0	7.2	Presence
16.	Hangar 17	.8	7.4	Presence
17	1535 Lab	.5	7.2	Absent
18.	NCO Club	1.2	7.4	Absent
19.	3575	0	7.4	Absent
20.	2137	.8	7.4	Absent
21.	2086-A	1.0	7.2	Absent

Listed above are all the samples taken on Nov 30, 1993.

- AAFB Total Coliform Sampling Results (EA Modified), 12/1/93-12/20/93

BIOENVIRONMENTAL ENGINEERING SERVICES
89th MEDICAL GROUP/SGPB
1535 COMMAND DRIVE SUITE C-108
ANDREWS AFB MD 20331-7002
FAX: (301) 981-9657 / DSN 858-9657
VOICE: (301) 981-3380 / DSN 858-3380

FAX TRANSMISSION

FROM: SSgt James Perry

TO: Don Klingler

SUBJECT: Water

MESSAGE:

NUMBER OF PAGES (INCLUDING THIS COVER): 2

[redacted]

Here is the summary of what sampling took place in Dec here on andrews. The samples listed below was with regular sampling with whirl-Pak bags.

		LOCATION	POS/NEG	DATE SAMPLED
*	1.	113 TFW	0	Dec 1
*	2.	Bee lab	0	Dec 1
*	3.	MGMC	13	Dec 8
*	4.	Lousiana	2	Dec 8

The samples listed below was with the new method (cups). The locations with a * was used for this month's report.Samples with a (N) not reportable to state.

	1.	Lousiana	0	Dec 15
	2.	113 TFW	0	Dec 15
(N)	3.	Child Dev Ctr.	0	Dec 15
	4.	Youth Ctr.	0	Dec 15
	5.	Hangar 8	0	Dec 15
	6.	MGMC	0	Dec 15
(N)	7.	Water Truck 80	0	Dec 15
*	8.	Hangar 2	0	Dec 15
	9.	Bee lab	0	Dec 15
*	10.	Jerstad Ct	0	Dec 15
(N)	11.	Water Truck 47	0	Dec 15
	12.	Bee Lab	0	Dec 16
	13.	113 TFW	0	Dec 16
	14.	MGMC	0	Dec 16
	15.	Jerstad	0	Dec 16
	16.	Hangar 2	0	Dec 16
	17.	Hangar 8	0	Dec 16
(N)	18.	Child Dev Ctr.	0	Dec 16
	19.	Youth Ctr.	0	Dec 16
*	20.	Youth CTR.	0	Dec 20
*	21.	Hangar 8	0	Dec 20

- AAFB Total Coliform Sampling Results, January 1994

[redacted]

BIOENVIRONMENTAL ENGINEERING SERVICES
89th MEDICAL GROUP/SGPB
1535 COMMAND DRIVE SUITE C-108
ANDREWS AFB MD 20331-7002
FAX: (301) 981-9657 / DSN 858-9657
VOICE: (301) 981-3380 / DSN 858-3380

FAX TRANSMISSION

FROM: 89 MG/SGPB
1535 COMMAND DRIVE SUITE C-108
ANDREWS AFB MD 20331-7002

TO: Chris Gould

SUBJECT: Sample Results

MESSAGE: If you need anything give me a call

SSgt Perez

NUMBER OF PAGES (INCLUDING THIS COVER): 4

[illegible]MENTAL ENGINEERING [illegible]AFB, MD 2033[illegible]-7002	PHONE: 981-3380	MONTH of: JAN	1994	WATER SAMPLE LOG SHEET 29

[illegible]LLECTION [illegible]OINT	TYPE OF TEST REQUESTED	SAMPLE NUMBER	DATE AND TIME OF COLLECTION	DATE AND TIME OF EXAM.	Cl_2	pH	COLLECTED BY INITIALS	VOLUME FILTERED	PRESENCE/ ABSENCE OR COLIFORM COLONIES /100 ml	SIGNATURE OF LAB. TECHNICIAN	REMARKS
[illegible] Lob	Total Coliform	1045 BC-01-01	JAN 5 1994	JAN 5 1994 1130	2.0	7.4	[illegible]	100	A	[illegible]	Colilert
[illegible] FD	Total Coliform	1000 BC-01-02	JAN 5 1994	JAN 5 1994 1130	∅	7.8	[illegible]	100	A	[illegible]	Colilert
[illegible]nie 3	Total Coliform	0930 BHC-01-01	JAN 5 1994	JAN 5 1994 1130	∅	7.6	[illegible]	100	A	[illegible]	Colilert
[illegible]nie 9	Total Coliform	0945 BHC-01-02	JAN 5 1994	JAN 5 1994 1130	.5	7.6	[illegible]	100	A	[illegible]	Colilert
[illegible]ne	Total Coliform	AC-01-01	Jan 5 1994	[illegible]	—	—	CBK	100	∅	[illegible]	
[illegible]ne 3	Total Coliform	BH A-01-01	Jan 5 1994	JAN 5 1994	—	—	[illegible]	100	∅	[illegible]	
[illegible]ne 9	Total Coliform	BH-01-02	Jan 5 1994	JAN 5 1994	—	—	[illegible]	100	∅	[illegible]	
[illegible] FW	Total Coliform	A-01-01	Jan 5 1994	[illegible]	—	—	[illegible]	100	∅	[illegible]	
[illegible]35 Bee Lab	Total Coliform	A-01-02	Jan 5 1994	JAN 5 1994	—	—	[illegible]	100	∅	[illegible]	
AC AFTER	Total Coliform	AC-01-02	Jan 5 1994	JAN 5 1994	—	—	CBK	100	∅	[illegible]	
1535	Flouride	AFL-01-01	Jan 5 1994	Jan 5 1994	—	—	CBK	25	—	[illegible]	.6 mg/l
Bunie 3	Flouride	BH AFL-01-01	Jan 5 1994	Jan 5 1994	—	—	CBK	25	—	[illegible]	1.5 mg/l
AC Before	Total Coliform	AC-01-03	Jan 12 1994	Jan 13 1994	—	—	CBK	100	∅	[illegible]	
MGMC	Total Coliform	A-01-03	Jan 12 1994	Jan 13 1994	1.0	7.6	CBK	100	∅	[illegible]	
[illegible]sonville Pumphouse	Total Coliform	BH-01-01	Jan 12 1994	Jan 13 1994	2.0	6.5	CBK	100	∅	[illegible]	

[illegible] ENVIRONMENTAL ENGINEERING
[illegible] AFB, MD 20331-7002

PHONE: 981-3380

MONTH of: Jan / 1994

WATER SAMPLE LOG SHEET

COLLECTION POINT	TYPE OF TEST REQUESTED	SAMPLE NUMBER	DATE AND TIME OF COLLECTION	DATE AND TIME OF EXAM.	Cl_2	pH	COLLECTED BY INITIALS	VOLUME FILTERED	PRESENCE/ ABSENCE OR COLIFORM COLONIES /100 ml	SIGNATURE OF LAB. TECHNICIAN	REMARKS
[illegible] 312	Total Coliform	DH-01-02	Jan 12 1994	Jan 13 1994	2.0	6.8	CBK	100	Ø	Chadwick B. [illegible]	
[illegible] 313	Total Coliform	DH-01-03	Jan 12 1994	Jan 13 1994	2.0	6.8	CBK	100	Ø	Chadwick B. [illegible]	
[illegible] 314	Total Coliform	DH-01-04	Jan 12 1994	Jan 13 1994	2.0	6.8	CBK	100	Ø	Chadwick B. [illegible]	
[illegible] 308	Total Coliform	DH-01-05	Jan 12 1994	Jan 13 1994	2.0	6.8	CBK	100	Ø	Chadwick B. [illegible]	
QC AFTER	Total Coliform	QC-01-09	Jan 12 1994	Jan 13 1994	—	—	CBK	100	Ø	Chadwick B. [illegible]	* Side By Side Samples with white Bottles
EAST Tower	Total Coliform	SAC-01-0[illegible]	Jan 12 1994	Jan 13 1994	.5	7.4	CBK	100	A	Chadwick B. [illegible]	
[illegible] Tower	Total Coliform	SAC-01-02	Jan 12 1994	Jan 13 1994	.5	7.4	CBK	100	P	Chadwick B. [illegible]	
QC Before	Total Coliform	QC-01-05	Jan 14 1994	Jan 15 1994	—	—	CBK	100	Ø	Chadwick B. [illegible]	* Side by Side ~~Samples~~
[illegible] whirl-Pac	Total Coliform	SA-01-01	Jan 14 1994	Jan 15 1994	1.0	7.4	Naval PC collected Samples *	100	Ø	Chadwick B. [illegible]	
[illegible] Bottle	Total Coliform	SA-01-02	Jan 14 1994	Jan 15 1994	1.0	7.4	CBK	100	Ø	Chadwick B. [illegible]	
QC Before 1	Total Coliform	QC-01-06	1400 JAN 21 1994	1400 JAN 22 1994	—	—	JKF	100	Ø	[illegible]	
Hangar 2	Total Coliform	A-01-04	1400 JAN 21 1994	1400 JAN 22 1994	.8	7.5	JKF	100	Ø	[illegible]	
QC 2	Total Coliform	QC-01-07	1410 JAN 21 1994	1400 JAN 22 1994	—	—	JKF	100	Ø	[illegible]	
Teestand	Total Coliform	A-01-05	1100 JAN 21 1994	1400 JAN 22 1994	1.3	7.3	JKF	100	Ø	[illegible]	
QC End 3	Total Coliform	QC-01-08	1430 JAN 21 1994	1400 JAN 22 1994	—	—	JKF	100	Ø	[illegible]	

* Sample was collected by Naval PC Ctrs to determine if procedure was correct.

ENVIRONMENTAL ENGINEERING
ANDREWS AFB, MD 20331-7002
PHONE: 981-3380

MONTH of: Jan 1994

WATER SAMPLE LOG SHEET 31

COLLECTION POINT	TYPE OF TEST REQUESTED	SAMPLE NUMBER	DATE AND TIME OF COLLECTION	DATE AND TIME OF EXAM.	Cl_2	pH	COLLECTED BY INITIALS	VOLUME FILTERED	PRESENCE/ ABSENCE OR COLIFORM COLONIES /100 ml	SIGNATURE OF LAB. TECHNICIAN	REMARKS
Feestad	Flouride	AFL-01-02	1100 JAN 21 1994	1130 JAN 21 1994	—	—	[illegible]	25	N/A	[illegible]	.8 mg/l
QC Before	Total Coliform	QC-01-08	JAN 26 1994	JAN 27 1994 CBK	—	—	CBK	100	ϕ	[illegible]	
280-3 Louisiana	Total Coliform	A-01-06	JAN 26 1994	JAN 27 1994 CBK	.2	7.8	CBK	100	ϕ	[illegible]	
Hanger 8	Total Coliform	A-01-07	JAN 26 1994	JAN 27 CBK	.5	7.3	CBK	100	ϕ	[illegible]	
Youth Center	Total Coliform	A-01-08	[illegible]	7 CBK	.8	7.2	CBK	100	ϕ	[illegible]	
Watering Truck SC	Total Coliform	A-01-09	JAN 26 1994	JAN 27 1994 CBK	.1	7.4	CBK	100	ϕ	[illegible]	
SC After	Total Coliform	SC-01-09	[illegible] 1994	JAN 27 CBK	—	—	CBK	100	ϕ	[illegible]	
Positive QC	Total Coliform	QC-01-10	JAN 26 1994	JAN 27 1994 CBK	—	—	CBK	100	ϕ	[illegible]	
Ending QC	Total Coliform	QC-01-11	[illegible] 1994	7 CBK	—	—	CBK	100	ϕ	[illegible]	
ville 312	Flouride	AFL-01-03	Jan 26 1994	Jan 26 1994	—	—	CBK	25	—	[illegible]	.5 mg/l
280-3 Louisiana	Flouride	AFL-01-03	Jan 26 1994	Jan 26 1994	—	—	CBK	25	—	[illegible]	1.0 mg/l
East Tower	Total Coliform	SPC-01-03	0930 JAN 27 1994	JAN 28 1994	.2	7.5	[illegible]	100	A	[illegible]	Colilert
West Tower	Total Coliform	SPC-01-04	0900 JAN 27 1994	JAN 28 1994	.1	7.5	[illegible]	100	A	[illegible]	Colilert
Youth Center	Flouride	AFL-01-04	0915 JAN 27 1994	JAN 27 1994	—	—	[illegible]	25	—	[illegible]	1.1 mg/l
Child Develop	Total Coliform	SPC-01-05	0930 JAN 27 1994	JAN 28 1994	.5	7.3	[illegible]	100	A	[illegible]	Colilert

- MDHMH Reports of an Interim Survey of Bioenvironmental Engineering Water Laboratory, 6/29/93 and 9/30/93

BIOENVIRONMENTAL ENGINEERING SERVICES
89th MEDICAL GROUP/SGPB
1535 COMMAND DRIVE SUITE C-108
ANDREWS AFB MD 20331-7002
FAX: (301) 981-9657 / DSN 858-9657
VOICE: (301) 981-3380 / DSN 858-3380

FAX TRANSMISSION

FROM: Maj McGowan

TO: Chris Gould
EA Engineering

SUBJECT:

MESSAGE:

NUMBER OF PAGES (INCLUDING THIS COVER): 7

State of Maryland

LABORATORIES ADMINISTRATION
DEPARTMENT OF HEALTH AND MENTAL HYGIENE
201 WEST PRESTON STREET • P.O. BOX 2355 • BALTIMORE, MARYLAND 21203-2355 • ~~XXXXXXXXXXXX~~ (410) 225-6150

Nelson J. Sabatini
Secretary

J. Mehsen Joseph, Ph.D.
Director

June 29, 1993

Department of the Air Force
Bioenvironmental Engineering
Water Laboratory
ATTN: MSgt. Rafael Cruz
SGPB Andrews Air Force Base
1535 Command Drive, Suite C-108
Andrews AFB, Maryland 20331-7002

Dear MSgt. Cruz:

Enclosed is the most recent update of your laboratory's certificate. Some explanatory notes may be useful to you:

1. Several analysts are provisionally certified, and other names submitted have not been listed. This is a result of non-participation in the MF92 proficiency series. Because the departure of the only remaining fully-certified analyst is imminent, steps should be taken to secure blind proficiency samples for those analysts that will have primary responsibility for water analysis. Please call me if you need more information on this process.

2. Some analysts have been certified for back-up work only. This is because lab contact is so infrequent.

3. The comparative test results for Colilert must be submitted by September 30, 1993. Our files show that this data has not yet been provided.

4. I am returning all copies of the personnel registration forms submitted with your application. As in last year's application, no information was provided re: training and experience of these personnel. Please complete and return these as soon as possible.

Please feel free to call on me, if I can assist your completion of these requirements in any way.

Sincerely,

Deanna J M B

Deanna Murphy Baxam
Water Quality Laboratory
Certification Officer

DMB/kk RAFCRUZ.51

Enclosures

Maryland Department of Health and Mental Hygiene
Laboratories Administration

Report of an Interim Survey of
Bioenvironmental Engineering
Water Laboratory
89 MG/SGPB, 1535 Command Drive
Suite C-108
Andrews AFB, MD 20331-7002

on September 30, 1993
by
Deanna Murphy Baxam DMB
Water Quality Laboratory Certification Officer
Division of Microbiology
Laboratories Administration
Maryland Department of Health and Mental Hygiene
201 West Preston Street
Baltimore, Maryland 21201

This report summarizes the findings of an interim survey of this laboratory for compliance with the minimum elements required by the Environmental Protection Agency and or the Department of Health and Mental Hygiene for certification under the Safe Drinking Water Act. The following deviations must be corrected:

General Laboratory Practices

1. The analyst must check for a thiosulfate residual each time a sample is analyzed. This was noted as a repeat deviation. The test is to be performed using 0.1 Normal iodine solution.

2. Filtration funnels are to be calibrated and indelibly marked at the 100 ml level.

3. The Colilert comparator had been held past its expiration date. It was recommended that a new comparator be ordered.

4. It was noted that all lots of media received must be dated with the date of receipt and the date opened.

5. It was recommended that the calibration check of the thermometer in the water bath be repeated. A correction factor of +1.1° C had been recorded. The deviation from previous checks indicated that this reading may have been erroneous.

Quality Assurance Program

1. Once per quarter the laboratory must run spore tests in the autoclave. It was agreed that spore packs could be obtained from the hospital laboratory.

2. The laboratory must obtain a non-coliform culture for negative control testing of media and for incubation with each batch of fecal coliform samples.

Remarks

It was also noted that the laboratory had submitted comparative tested data using membrane filtration and ONPG MMO-MUG techniques. This data was deemed acceptable, and the laboratory has since been certified to perform ONPG MMO-MUG Determinations.

Personnel Certified

	TCMF	ONPG MMO-MUG
A1C Chadwick Kinser	X	X
SSgt James F. Percy	X	X
A1C D. Blaylock-Short	X +	X +
TSgt Rosa L. McNeil	X +	X +

+ Certified for back-up work only.

TCMF = Total Coliform Membrane Filter
ONPG MMO-MUG = ONPG MMO-MUG Determinations

This status is conditioned on acceptable performance evaluation results for the MF93 proficiency study, which will be reported in March, 1994.

Conclusion

This laboratory was in substantial compliance with the requirements for certification as a Water Quality Laboratory. The deviations noted in this report must be corrected within 30 days of receipt of the final report. All corrective actions must be submitted in writing to this office for review.

DMB:ncw BIOENINT.51

State of Maryland

DEPARTMENT OF HEALTH AND MENTAL HYGIENE
LABORATORIES ADMINISTRATION

This is to certify that the following personnel of the

BIOENVIRONMENTAL ENGINEERING WATER LABORATORY, USAF MALCOLM GROW MED. CTR.
Laboratory

MGMC/SGPB 1535 Command Drive, Suite C-108, Andrews AFB, MD 20331-7002
Address

have been approved to perform the indicated procedures on Drinking Water
in connection with interstate regulations, and/or Maryland Law.

Name	Tests approved
Major Lawrence A. McGowan, Chief, Bioenvironmental Engineering	
MSGT Rafael Cruz Superintendent of Operations	
+ A1C Davanaliz Blaylock-Short A1C Chadwick Kinser SSgt James F. Percy + TSgt Rosa L. McNeil	<u>Microbiology</u> <u>Group II</u> Total Coliform Membrane Filter <u>Group IV</u> ONPG MMO-MUG Determinations

+ Certified for Back-up Work Only.

This certificate expires June 30, 1994 unless sooner withdrawn.
Certification No. G-1042
Date issued: February 23, 1994

J. Mehsen Joseph
Director, Laboratories Administration

DHMH-00155 11/91

- Martel Lab and Sampling Audit, 12/14/93

FAX FROM MARTEL

1025 Cromwell Bridge Road • Baltimore, Maryland 21204 • Telephone (410) 825-7790 • Facsimile (410) 821-1054
250 Meadowfern, Suite 102 • Houston, Texas 77067 • Telephone (713) 872-9100 • Facsimile (713) 872-7916
1438 Sangamon Avenue • Springfield, Illinois 62702 • Telephone (217) 522-0009 • Facsimile (217) 522-0009

TO: DOUG PIPER

ORGANIZATION: EA

RECIPIENT'S FAX NO.: 771-4204

FROM: J. WOLFKILL

DATE: December 14, 1993

NO. OF PAGES: (including cover page) 3

RE: ANDREWS AFB VISIT

MESSAGE: The information provided below is a summary of Joseph Wolfkill's visit with the staff of the Andrews Air Force Base Bioenvironmental Water Lab and Mr. Doug Piper of EA.

A lot of important information was exchanged during a two-hour question and observation period on December 13, 1993. Rather than recap all that was discussed, I will limit my comments to the major concern, the elimination of the drinking water sample analyses being compromised by either sampling or analytical techniques.

Observations and Recommendations:

Sampling:

The field sample container, a plastic cooler, had been cleaned thoroughly since the last parallel sampling series. All indications are that this was potentially a primary source of sample contamination. Any containers that come in contact with drinking water samples must be very clean and sterile if possible.

The "whirl packs" used were outdated, and stored in wet testing kits. Now they are being sealed dry and discarded if compromised or old.

Whirl packs necessarily get wet during sampling. Bacteria may be transferred when the wet outside of these packs comes in contact with a contaminated surface. Since a rack of samples, in contact with each other, is stored for several hours, any or all of the samples could be contaminated on the outside.

Outside taps are frequently used for sampling. Because of splashing, water storage in hoses, and the general outside environment, it is more desireable to sample from an inside tap, preferably a bathroom.

The hot water is turned on for 2-3 minutes before the cold water flush. There is no real reason to do this; sediment and bacteria can build in hot water lines and therefore contaminate the sample.

Analytical:

The whirl packs are untwisted and the sample is poured from the packs, right over the twist tie end, that is wetted with external water. If bacteria are present on the outside of the bag, then it is washed from the bag into the sample aliquot by the sample itself. If the sample must be poured from the whirl pack, it should be directed to flow over the broad edge of the pack.

The technical knowledge and expertise of the staff seems exemplary. It seems plain that the analytical techniques employed are trustworthy.

Strong Recommendation:

Sample with hard sterile bottles with thiosulfate present, or at the minimum, sample with both whirl packs and bottles in parallel for a while, to determine if contamination may be coming from the outside of the packs.

Other Recommendations:

The positive control standard, acquired from the base hospital, should be employed and then discarded. Maintaining it in the laboratory merely provides a possible source of analytical contamination. In addition, if the positive control gets negative results, **the entire day's sampling and analytical work is compromised, and must be reperformed.** It is simpler to perform the positive control only when necessary and with a clearly positive (unstored) control.

All positive membrane filtration analyses must be confirmed.

In addition to performing a media only blank when performing the ONPG MO-MUG determination, the sterile blank water should also be performed.
This will check technique as well as media supply.

Conclusion:

I believe the strongest probability is that the random positive results are due to contamination during sampling and analysis from the environment surrounding the sealed whirl packs. Upon analysis, the contamination is transferred when pouring the sample over the edges of the packs.

- Martel Telecon, 2/7/94

COMMUNICATIONS RECORD FORM

Distribution: (X) Chris Riley ( )
( ) 11206.95 project file ( )
( ) (X) Author

Project Number: 11206.95

Person Contacted: Mr. Joe Wolfkill, Martel Laboratories Date: 2/7/94

Title or Department: President

Type of Contact: Telephone

Address\Phone: (410) 825-7790 Contacted By: W. Goodfellow

Communications Summary: Mr. Wolfkill indicated that since Andrews AFB recently went through the certification procedure with Maryland Department of the Environment and the resulting checklist audit of the analytical procedures, his audit focus was whether the procedures deviated from those required for MDE were still being performed correctly. His conclusion was that Andrews AFB was performing the tests correctly. His audit also evaluated the sampling procedures since this area is often neglected during most laboratory certification audits. His conclusion as stated in his 14 December 1993 Audit Report was that sampling was a potential problem at the facility. Side by side results with two independent laboratories with separate samples supported the findings of the audit. Mr. Wolfkill was very impressed with the laboratory staff's expertise with regards to the analytical techniques.

Signature: Wm L. Goodf.

6.0 Cross Connection Control Plan

- CCCP Submittal to MDNR, 3/12/91
- CCCP Acceptance by MDNR, 3/26/91
- CCCP Telecon, 12/10/93

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS 1776TH AIR BASE WING (MAC)
ANDREWS AIR FORCE BASE, WASHINGTON, D.C. 20331-5000

MAR 12 1991

REPLY TO ATTN OF: 1776 ABW/DEEV

SUBJECT: Submittal for Approval Cross Connection Control Program

TO: Maryland Department of the Environment
Water Supply Program
2500 Broening Highway
Baltimore, MD 21224
ATTN: Zora Izadi

1. Request you review and approve the following submittal which will serve as the base's Cross Connection Control Plan as required by COMAR 26.04.01.32. This submittal is based on the basic policies for maintaining plumbing systems on Air Force installations. It guides and instructs all personnel who supervise, inspect, repair, install and maintain plumbing systems and devices. It adopts the Uniform Plumbing Code (UPC) and Uniform Plumbing Code Illustrated Training Manual for operations and maintenance purposes. This plan has been implemented in its entirety and is currently in effect at Andrews AFB.

2. The Department of the Air Force has been performing cross-connection activities at its installations for a number of years. The cross-connection program is well defined and structural with a designated organizational responsibility. AFR 91-13 provides guidance on how to develop and implement an effective cross connection program. The following detail specific guidance on how Andrews AFB implements its installation plan. Headquarters Air Force Engineering and Services Center (AFESC) issues policies and instructions down through major command engineers who then directs their base civil engineers and directors of medical services to carry out these responsibilities. Andrews AFB has the following responsibilities:

a. The Base Civil Engineer:

1. Appoints an engineer or senior plumbing supervisor as the UPC interpreter and advisor.

2. Ensures personnel follow the UPC and Illustrated Training Manual when inspecting, testing, repairing or replacing plumbing systems and fixtures.

3. Maintains an aggressive program to identify, isolate, record and correct cross connection and other potential sources of distribution system contamination.

DEEV READ

4. Makes sure plumbing personnel can properly test, install, maintain and repair backflow prevention devices.

5. Conducts a facility survey of plumbing devices and systems every five years and updates records. Surveys are coordinated with the base bioenvironmental engineer.

6. Reviews all plans and drawings of new or modified water systems to identify potential cross connections and installs specified control devices where required. Also identifies cross connections requirements for design into new construction of facilities.

7. Notifies appropriate authorities, i.e. State Department of Environment and Major Command, when water supply becomes contaminated.

b. Director of Base Medical Services:

1. Reviews the degree of hazard of each cross connection and assigns the proper classification.

2. Reviews plans for water system modification to prevent cross-connection and to identify existing cross-connections or other potential sources of contamination or pollution.

3. Certification is mandatory to make sure personnel have the qualifications to properly test and maintain backflow prevention devices. It also fulfills requirements under Public Law 93-523, The Safe Water Act.

c. Minimum requirement for certification is that the technician must first satisfactorily complete an approved training program at one of the following:

1. Sheppard Air Force Base Technical Training Center's Mobile Training Course, Backflow Prevention Devices.

2. A Backflow Prevention Course approved by the host state.

3. A Backflow Prevention Course sponsored by a nationally or internationally recognized professional organization, unless it conflicts with the host state requirement.

d. The initial certification is valid for three years. Recertification is done by our major command using data furnished by the Base Civil Engineer. To be recertified, the following must be included but not limited to:

1. The date the approved training course is completed, the major command can waive the course if the plumbing shop supervisor confirms the technician inspected and tested at least 50 double check and/or reduced pressure type backflow devices since last certified.

2. A summary of related training since last certified.

3. The inspection frequency and types of devices inspected by the technician each year of current certification.

4. The Cross Connection Control Program requires a survey of all facilities and water-using equipment and systems as follows:

a. Skilled civil engineering plumbers, in coordination with the Base Bioenvironmental Engineer, conduct the survey. They identify locations of backflow prevention devices, their adequacy, and if more devices are needed. The surveys must be performed at least every five years and records updated each time.

b. The team records results of the surveys on Air Force Form 848, Inventory of Cross Connection Control and Backflow Prevention Devices. This information is used to maintain other records for installed devices and testing schedules. The plumbing shop supervisor documents requirements for new and additional backflow prevention and places them in a suitable program.

5. The Base Civil Engineer must establish a schedule for testing and inspecting all backflow protection devices, including air gaps. A certified backflow technician must inspect all cross-connection to ensure the following:

a. There is an approved air gap.

b. The backflow prevention devices are in good condition.

c. New devices are installed correctly. An inspection is made within one week after installation and follow-up inspection three months later.

6. The information provided was taken from Air Force Regulation 91-13 dated 15 Nov 90. It is only an overview of the Air Force Cross-Connection Control Device Program. The Air Force AF Form 848 contains an inventory of all Cross-Connection and Backflow Prevention Devices Located on Andrews Air Force Base. Andrews AFB does not have its own water source, but receives water from the Washington Aquaduct Army Corps of Engineers. The water is stored in a reservoir on base and then distributed throughout the base by way of loop distribution system.

7. Attachments one and two are AF Forms 483 and AF Forms 848, respectively. The AF Form 483 is issued upon satisfactorily completing the Air Force Backflow Prevention Course. The AF Form 848 is a complete inventory of all Backflow Prevention Devices installed on Andrews AFB.

8. If you require additional information, please call MSgt Brown at (301)981-2579.

signed

LARRY A. CARSON
Chief, Engineering and
Environmental Planning Branch

2 Atchs
1. AF Form 483
2. AF Form 848

Post-it® brand Fax Transmittal Memo 7672

No. of Pages 4 | Today's Date 10/6/93 | Time

To Larry Graham	From Zohreh Rzaki
Company Andrews Air Force Base	Company MDE-Public Drinking Water Prog.
Location	Location 2500 Broening Hwy
	Dept. Charge
Fax # (301) [illegible]	Fax # (410) 631-4894
Telephone #	Telephone # (410) 631-3702

Comments

Original Disposition: ☐ Destroy ☐ Return ☐ Call for pickup

CERTIFICATE OF COMPETENCY	CERTIFICATE NO. #35
NAME (Last, First, Middle Initial) HILLMAN, RICK A.	DATE Exp: Nov 91 22 Nov 88
COMMAND SAC	INSTALLATION Loring AFB

HAS SUCCESSFULLY COMPLETED THE PRESCRIBED COURSE OF INSTRUCTION AND/OR PRACTICAL TEST AS REQUIRED BY CURRENT DIRECTIVES AND IS DEEMED QUALIFIED TO PERFORM THE DUTIES OF

BACKFLOW PREVENTION TECHNICIAN

TYPED NAME, TITLE AND ORGN.	SIGNATURE
DELBERT C. JACKSON, SMS Structures Manager HQ SAC/DEMM	Delbert C. Jackson

AF FORM 483, FEB 80 PREV. ED. WILL BE USED

REFRESHER TRAINING

DATE	INSTRUCTOR	DATE REFRESHED

AF FORM 483, FEB 80 (Reverse) ☆U.S. GPO: 1987-17

ATCH 1

INVENTORY OF CROSS-CONNECTION CONTROL AND BACKFLOW PREVENTION DEVICES							AIR FORCE BASE: Andrews AFB, Md.	PERSONNEL MAKING INVENTORY: MSgt Miller AND TSgt Smith				DATE: 1 Aug 89
CONTROL NO. ISSUED CROSS-CONNECTION	LOCATION Bldg #	ITEM/FACILITY/ SYSTEM PROTECTED	POTENTIAL CONTAINMENT OR POLLUTANT	DEGREE OF HAZARD	BACK PRESSURE POTENTIAL	BACK SIPHONAGE POTENTIAL	TYPE CONTROL INSTALLED OR (REQUIRED)	DATA ON DEVICE INSTALLED: MAKE	MODEL	SIZE	COMMENTS	Inspection Interval
BC811	1245	Lawn Sprinkler	Chemicals	II	NO	YES	Double Check	Febco	805	2 1/2"		24m
161589	1358	Filter Room	Chlorine	II	YES	YES	R.P. Device	WATTS	909	2"		24m
A8123	1352	Mech. Room	Hot Water	II	YES	YES	R.P. Device	Febco	825Y	2"		24m
~~184888~~	~~3305~~	~~Mech. Room~~	~~Hot Water~~	~~II~~	~~YES~~	~~YES~~	~~R.P. Device~~	~~WATTS~~	~~909~~	~~3/4"~~		~~24m~~
241297	4883	Golf Course Maintance	Fire Sys.	II	YES	YES	R.P. Device	WATTS	909	6"		24m
A7058	1645	Dormitory	A.C. Lines	II	YES	YES	R.P. Device	Febco	825Y	3/4"		24m
A7194	1625	Dormitory	A.C. Lines	II	YES	YES	R.P. Device	Febco	825Y	3/4"		24m
~~A7197~~	~~1621~~	~~Dormitory~~	~~A.C. Lines~~	~~II~~	~~YES~~	~~YES~~	~~R.P. Device~~	~~Febco~~	~~825Y~~	~~3/4"~~		~~24m~~
A7180	1639	Dormitory	A.C. Lines	II	YES	YES	R.P. Device	Febco	825Y	3/4"		24m
A7238	4686	Grass Maintenance	Fertilizer	II	NO	YES	R.P. Device	Febco	825Y	3/4"		24m
A7322	1648	Dormitory	A.C. Lines	II	YES	YES	R.P. Device	Febco	825Y	3/4"		24m
A7349	1635	Dormitory	A.C. Lines	II	YES	YES	R.P. Device	Febco	825Y	3/4"		24m
~~96634~~	~~1602~~	~~Dormitory~~	~~A.C. Lines~~	~~II~~	~~YES~~	~~YES~~	R.P. Device	WATTS	909	1 1/2"		24m
0478771	1235	Arts + Craft Center	Chemical	II	YES	YES	R.P. Device	WATTS	900	3/4"		24m
81905	1684	Commisary	Hot Water	II	YES	YES	R.P. Device	WATTS	909	2"		24m
~~86055~~	~~1353~~	~~Filter Room~~	~~Chlorine~~	~~II~~	~~NO~~	~~YES~~	~~R.P. Device~~	~~WATTS~~	~~909~~	~~3/4"~~		~~24m~~
~~206693~~	~~3517~~	~~Mech. Room~~	~~Hot Water~~	~~II~~	~~YES~~	~~YES~~	~~R.P. Device~~	~~WATTS~~	~~909~~	~~3/4"~~		[illegible]

ATCH 3

INVENTORY OF CROSS-CONNECTION CONTROL AND BACKFLOW PREVENTION DEVICES

AIR FORCE BASE: Andrews AFB, Md.

PERSONNEL MAKING INVENTORY: MSgt Miller AND TSgt Smith

DATE: 1 Aug 89

CONTROL NO. ISSUED CROSS-CONNECTION	LOCATION Bldg#	ITEM/FACILITY/SYSTEM PROTECTED	POTENTIAL CONTAINMENT OR POLLUTANT	DEGREE OF HAZARD	BACK PRESSURE POTENTIAL	BACK SIPHONAGE POTENTIAL	TYPE CONTROL INSTALLED OR (REQUIRED)	DATA ON DEVICE INSTALLED			COMMENTS	Inspection Intervals
								MAKE	MODEL	SIZE		
A7230	1522A	Copy Room Reproduction	Chemicals	III	YES	YES	R.P. Device	Febco	825Y	3/4"		6M
162201	1515	Boiler Plant #1	Chemicals	III	YES	YES	R.P. Device	WATTS	909	4"		6M
162761	1515	Boiler Plant #1	Chemicals	III	YES	YES	R.P. Device	WATTS	909	4"		6M
162509	1732	Boiler Plant #2	Chemicals	III	YES	YES	R.P. Device	WATTS	909	4"		6M
0410613	3409	Boiler Plant #3	Chemicals	III	YES	YES	R.P. Device	WATTS	900	1¼"		6M
123034	3409	Boiler Plant #3	Chemicals	III	YES	YES	R.P. Device	WATTS	909	3"		6M
D801	1791	Fab. Shop	Chemicals	III	YES	YES	R.P. Device	BEECO ~~WATTS~~	60	2"		6M

FORM 848 APR 81

INVENTORY OF CROSS-CONNECTION CONTROL AND BACKFLOW PREVENTION DEVICES

Andrews AFB, Md. | MSgt Miller AND TSgt Smith | 1 Aug 89

CONTROL NO. ISSUED CROSS-CONNECTION	LOCATION Bldg #	ITEM/FACILITY/SYSTEM PROTECTED	POTENTIAL CONTAMINANT OR POLLUTANT	DEGREE OF HAZARD	BACK PRESSURE POTENTIAL	BACK SIPHONAGE POTENTIAL	TYPE CONTROL INSTALLED OR (REQUIRED)	DATA ON DEVICE INSTALLED: MAKE	MODEL	SIZE	COMMENTS 31 July 89
41794	3459	Entomology	Insecticides	III	YES	YES	R.P. Device	WATTS	909	1"	Entomology Shop Moved
A7175	1522	Printing Reproduction	Developing Chemicals	III	YES	YES	R.P. Device	Febco	825Y	3/4"	Printer Removed 1989
	1352	O'Club Pool Filter Room	Chlorine	II	YES	YES	R.P. Device	Febco		2 1/2"	Building Removed 1988
41790	4686	Grass Maint.	Fertilizer	II	NO	YES	R.P. Device	WATTS	909	3/4"	Replaced Device 16 Feb 84

FORM 848 APR 81

TOTAL P.04

DEEV - File & work with Shops to ensure our [illegible] program is effective & continued. JAC 4/3/91

STATE OF MARYLAND
Department of the Environment
2500 BROENING HIGHWAY · BALTIMORE, MARYLAND 21224
(301) 631 - 3709

William Donald Schaefer
Governor

Robert Perciasepe
Secretary

-2 APR 91 ... 16

March 26, 1991

Mr. Larry A. Carson
Chief, Engineering and
Environmental Planning Branch
Department of the Air Force
Headquarters 1776th Air Base Wing(MAC)
Andrews Air Force Base, Washington, D.C. 20331-5000

Re: Cross Connection Control Program

Dear Mr. Carson:

I have reviewed the Andrews Air Force Base's Cross Connection Control Program. The Plan submitted are acceptable to this Program and it is in accordance with COMAR 09.20.11.05, Board of Commissioners of Practical Plumbing. A copy of the regulation regarding protection against Backflow and Backsiphonage is attached for your information.

If you have any questions, please do not hesitate to contact me at (301) 631-3709.

Sincerely yours,

Zohreh A. Izadi

Zohreh A. Izadi
Public Health Engineer
Water Supply Program

Enclosures

ZI.zi

.05 Protection Against Backflow and Backsiphonage.

A. Water Outlets. A potable water system shall be protected against backflow and backsiphonage by providing at each outlet an air gap between the potable water outlet and the flood level rim of the fixture it supplies or between the outlet and any other source of contamination, or, where an air gap is impracticable, as specified below:

(1) Low inlet to receptacles containing toxic substances, vats, storage containers, plumbing fixtures, by:

(a) An approved air gap fitting;

(b) Reduced pressure principle back pressure backflow preventer;

(c) Pressure vacuum breaker unit;

(d) Atmospheric vacuum breaker unit.

(2) Low inlet to receptacles containing non-toxic substances, steam, air, and food beverages, by:

(a) An approved air gap fitting;

(b) Reduced pressure principle back pressure backflow preventer;

(c) Pressure vacuum breaker unit;

(d) Atmospheric vacuum breaker unit;

(e) Approved double check valve assembly.

(3) Outlets with hose attachments which may constitute a cross connection by:

(a) An approved air gap fitting;

(b) Reduced pressure principle back pressure backflow preventer;

(c) Pressure vacuum breaker unit;

(d) Atmospheric vacuum breaker unit.

(4) Coils or jackets used as heat exchangers in compressors, degreasers, and other equipment involving toxic substances by:

(a) An approved air gap fitting;

(b) Reduced pressure principle back pressure backflow preventer;

(c) Pressure vacuum breaker unit.

(5) Heat exchangers for closed systems used for heat recovery or solar systems by:

(a) Two separate thicknesses of metal;

(b) Single thickness of metal provided the following conditions are met:

(i) Heat transfer fluid is non-toxic,

(ii) Pressure of potable water system is greater than double the pressure of the non-potable side,

(iii) Non-potable side is provided with relief valve set to discharge at a pressure equal to or less than ½ the operating pressure of the potable system.

(6) Direct connections, subject to back pressure systems to:

(a) Non-toxic substances by:

(i) An approved air gap fitting;

(ii) Reduced pressure principle back pressure backflow preventer;

(iii) Approved double check valve assembly.

(b) Toxic substances by:

(i) An approved air gap fitting;

(ii) Reduced pressure principle back pressure backflow preventer.

(c) Sewage and lethal substances by an approved air gap fitting.

B. A backflow preventer device or vacuum breaker approved as hereinafter provided.

C. Minimum required air gap.

(1) How measured. The minimum required air gap shall be measured vertically from the lowest end of a potable water outlet to the flood rim or line of the fixture or receptacle into which it discharges.

(2) Size. The minimum required air gap shall be twice the effective opening of a potable water outlet, unless the outlet is a distance less than three times the effective opening away from a wall or similar vertical surface, in which cases the minimum required air gap shall be three times the effective opening of the outlet. The minimum required air gap may not be less than shown in Table 09.20.11.05B(2). Minimum Air Gaps for Plumbing Fixtures.

EA ENGINEERING,
SCIENCE, AND
TECHNOLOGY, INC.

Project No. 11206.95
Task No. ______
Dept. No. 6112

COMMUNICATIONS RECORD FORM

Distribution: ( ) Don Klingler, ( ) Gerv Griffin,
( ) Doug Piper, (X) Dan Simon
, (X) Author

Person Contacted John Bossert Date 10 December 1993

Title Water/Waste Foreman

Affiliation Andrews AFB Type of Contact Phone

Address Same Person Making Contact Dan Simon

Ph (301) 981-2665

Communications Summary Topic: cross connection control program (CCCP)

I mentioned to John Bossert that the CCCP of 8/89 listed 24 active cross connections. Has there been any more installed? to which he responded "yes." Navy installed a (RPBP) 6" watts 909 on the 250,000 gallon res fire fighting tank. In addition, an air gap was placed at the 500,000 gal res fire fighting tank. Also, there are installed, but not listed on the CCCP inventory, at least 100 cross connections sizing from 1/2" to 3/4" for miscellaneous purposes not clearly defined. In addition, contractors may have put several backflow preventers in, but do not always report them. With respect to testing, John mentioned that the 24 RPBPs of the CCCP were tested by the schedule, but the Navy and the Air Guard had their own CCCP, which includes inventory and testing records. I requested testing records and an inventory of the Air Forces cross connections, and the testing records and John said he would provide testing records of the 24 active in CCCP and try to acquire the CCCP from the Navy and Gaurd. John also mentioned when any RPBP was installed, the RPBP was tested after installation and tested again 10 days later. The testing procedure simply involved connecting a pressure gauge to 2 different sets of 2 differential testing cocks and measuring differential pressure, then dropping the inlet pressure by a by-pass valve. When the pressure relief valve opens, the diff pressure is measured & normally opens at 5-7 psi.

Signature Dan Simon

EA 0079 4-9-92

7.0 Immediate Action Report

- Fire Reserve, 11/16/93
- WAD Acute Contamination, 12/2/93
- EA Letter, 12/16/93

EA Engineering, Science, and Technology

EA Mid-Atlantic
Hunt Valley/Loveton Center
15 Loveton Circle
Sparks, MD 21152
Telephone: 410-771-4950
Fax: 410-771-4204

16 November 1993
EA Project No. 11206.95

Major Lawrence A. McGowan
89 MG/SGPB
1535 Command Drive
Suite C-108
Andrews AFB, MD 20331-7002

Re: Bacteriological Contamination Project
Andrews Air Force Base

Dear Major McGowan:

Please request, in writing, what is required by WSSC to provide Andrews Air Force Base with a water supply system including operating storage and fire reserve. Based on the May 1987 Existing Water System Study by Boyle Engineering Corp., the peak hour flow was estimated at 6000 gpm in the year 2000, and the fire flow for Building 3066 was estimated at 5000 gpm for 4 hours.

Although there are other alternatives to a water supply source for Andrews, we need the above requirement in order to complete our cost analysis for the project. WSSC has indicated the request must come in writing from the customer.

Please address the request to:

Mr. Tim Hirrel,
Planning Manager
Water Resources Planning Section
Washington Suburban Sanitary Commission
14501 Switzer Lane
Laurel, MD 20707

Sincerely,

Donald E. Klingler

Donald E. Klingler
Project Manager

DEK\kmp
Enclosure

cc: \1120695\LETTERS\11-16-93.DEK

EA ENGINEERING, ®
SCIENCE, AND
TECHNOLOGY, INC.

Project No. 11206.95
Task No.
Dept. No. 6112

COMMUNICATIONS RECORD FORM

Distribution: ( ) ________, ( ) ________,

( ) ________, ( ) ________,

( ) Author

Person Contacted GEORGE PAPADOPOULOS Date 12-2-93

Title CHIEF BWS

Affiliation WAD COE Type of Contact PHONE CALL

Address ________ Person Making Contact DOUG PIPER

Communications Summary MR PAPADOPOULOS CONFIRMED THAT WAD HAD 1 CASE OF ACCUTE CONTAMINATION IN THE UPPER N.E. REGION OF WASHINGTON DC IN JUNE OF 1993. THE PROBLEM WAS FOUND IN A CLOSED SCHOOL. THE CONTAMINATION WAS TREATED AND MANY SITES THROUGH OUT THE WAD SYSTEM WERE MONITORED FOR TEN DAYS. NO PROBLEMS WERE DETECTED FOR THOSE TEN DAYS, AND THUS THE ~~[illegible]~~ STATE OF EMERGENCY WAS LIFTED.

Signature Doug [illegible]

EA 0079 4-9-92

EA Engineering, Science, and Technology

EA Mid-Atlantic
Hunt Valley/Loveton Center
15 Loveton Circle
Sparks, MD 21152
Telephone: 410-771-4950
Fax: 410-771-4204

16 December 1993
EA Project No. 11206.95

Major Lawrence A. McGowan
89 MG/SGPB
1535 Command Drive
Suite C-108
Andrews AFB, MD 20331-7002

Re: Bacteriological Contamination Project
Andrews Air Force Base

Dear Major McGowan:

In response to your request to investigate the report of WAD contamination in 1993, we contacted Mr. George Papadopoulos, Chief BWS, WAD, C of E.

Mr. Papadopoulos confirmed that WAD had one case of acute contamination in the upper north east region of Washington, DC in June of 1993. The problem was found in a closed school. The contamination was treated and many sites throughout the WAD system were monitored for ten days. No problems were detected for those ten days, and thus the state of emergency was lifted.

Sincerely,

Donald E. Klingler

Donald E. Klingler
Project Manager

DEK\kmp

cc: Ms. Michele Margolis
LtCol. John G. Garland, III
\1120695\LETTERS\MJRMCG12.16

APPENDIX B

WATER QUALITY RECORDS

This appendix contains water quality records for the following water treatment plants:

- Dalecarlia Water Treatment Plant (200 mgd)
- McMillan Water Treatment Plant (120 mgd)
- Potomac Water Treatment Plant (200 mgd)
- Patuxent Water Treatment Plant (22 mgd)

and for:

- Andrews AFB sampling events from 13 January to 25 August 1993

WASHINGTON AQUEDUCT DIVISION

U.S. ARMY ENGINEER DISTRICT, BALTIMORE

COMPOSITE ANALYSIS OF WATER

BY DALECARLIA LABORATORY

POTOMAC RIVER RAW WATER SUPPLY

1992	Chloroform	Bromodichloromethane	Chlorodibromomethane	Bromoform	Total Trihalomethanes	Endrin	Lindane	Methoxychlor	Toxaphene	2,4-D	2,4,5-TP(Silvex)	Benzene	Carbon Tetrachloride	1,2-Dichloroethane	Trichloroethylene	1,4-Dichlorobenzene	1,1-Dichloroethylene	1,1,1-Trichloroethane	Vinyl Chloride
	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
JANUARY	0.8	0.5	0.1	0.0	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FEBRUARY	0.7	0.6	0.1	0.0	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MARCH	0.8	0.5	0.0	0.0	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
APRIL	1.1	0.4	0.0	0.0	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAY	2.5	0.7	0.0	0.0	3.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JUNE	4.2	1.5	0.0	0.0	5.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JULY	1.0	0.0	0.0	0.0	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AUGUST	3.0	0.8	0.0	0.0	3.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SEPTEMBER	2.6	1.0	0.0	0.0	3.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTOBER	2.4	0.8	0.0	0.0	3.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NOVEMBER	3.7	0.9	0.0	0.0	4.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECEMBER	0.6	0.3	0.0	0.0	0.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVERAGE	1.9	0.6	0.0	0.0	2.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAXIMUM	4.2	1.5	0.1	0.0	5.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MINIMUM	0.6	0.0	0.0	0.0	0.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

1992	Total Organic Carbon	Methylene Blue Active Substances	Chemical Oxygen Demand	Disolved Oxygen	Conductivity	Total Coliform	Fecal Coliform	Algae Count	Gross Alpha	Gross Beta	Radium (226-228)	Strontium-90	Tritium
	mg/l	mg/l	mg/l	mg/l	µmhos/cm	MPN/100 ml	MPN/100 ml	Org./ml	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
JANUARY	4.0	<.10	20.0	8.8	205	18035	280						
FEBRUARY	2.2	<.10	5.0	9.7	230	2878	85						
MARCH	2.6	<.10	5.0	8.9	172	4889	498						
APRIL	2.9	<.10	7.6	8.4	202	8131	1041						
MAY	2.1	<.10	3.7	8.3	211	751	131	341					
JUNE	2.4	<.10	5.0	7.9	256	1411	284	325					
JULY	3.9	<.10	9.0	7.8	308	680	405	227					
AUGUST	3.0	<.10	5.0	7.3	320	1514	65	155					
SEPTEMBER	3.1	<.10	8.1	7.8	320	806	151	58					
OCTOBER	3.2	<.10	7.2	8.8	283	826	124	44					
NOVEMBER	4.6	<.10	10.0	9.7	211	29209	953						
DECEMBER	2.9	<.10	8.8	11.2	162	17588	2063						
AVERAGE	3.1	<.10	7.8	8.7	240	7227	507	96					
MAXIMUM	4.6	<.10	20.0	11.2	320	29209	2063	341					
MINIMUM	2.1	<.10	3.7	7.3	162	680	65	44					

DALECARLIA WATER TREATMENT PLANT FINISHED WATER

1992	Chloroform	Bromodichloromethane	Chlorodibromomethane	Bromoform	Total Trihalomethanes	Endrin	Lindane	Methoxychlor	Toxaphene	2,4-D	2,4,5-TP(Silvex)	Benzene	Carbon Tetrachloride	1,2-Dichloroethane	Trichloroethylene	1,4-Dichlorobenzene	1,1-Dichloroethylene	1,1,1-Trichloroethane	Vinyl Chloride
	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
JANUARY	19.1	9.1	1.8	0.0	30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FEBRUARY	24.4	11.6	2.6	0.0	38	ND	ND	ND	ND	ND	ND	*	ND	ND	ND	ND	ND	ND	ND
MARCH	17.4	6.8	1.3	0.0	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
APRIL	17.2	8.3	2.2	0.0	27	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAY	41.0	11.5	1.5	0.0	54	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JUNE	62.4	11.7	1.2	0.0	75	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JULY	66.0	14.0	1.8	0.0	81	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AUGUST	67.5	15.4	1.8	0.0	84	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SEPTEMBER	58.0	18.3	3.1	0.0	79	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTOBER	50.4	12.2	1.2	0.0	63	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NOVEMBER	43.7	8.3	0.7	0.0	52	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECEMBER	15.7	8.4	1.9	0.0	26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVERAGE	40.2	11.3	1.7	0.0	53	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAXIMUM	67.5	18.3	3.1	0.0	84	ND	ND	ND	ND	ND	ND	*	ND	ND	ND	ND	ND	ND	ND
MINIMUM	15.7	6.8	0.7	0.0	25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

1992	Total Organic Carbon	Methylene Blue Active Substances	Chemical Oxygen Demand	Disolved Oxygen	Conductivity	Total Coliform	Fecal Coliform	Algae Count	Gross Alpha	Gross Beta	Radium (226-228)	Strontium-90	Tritium
	mg/l	mg/l	mg/l	mg/l	µmhos/cm	MPN/100 ml	MPN/100 ml	Org./ml	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
JANUARY	2.1	<0.1	15.0	9.6	231	0.0	0.0		<2	2		0.6	<500
FEBRUARY	1.0	<0.1	5.5	10.1	261	0.0	0.0						
MARCH	1.6	<0.1	0.0	9.5	205	0.8	0.0						
APRIL	2.0	<0.1	3.6	7.2	233	0.0	0.0		<2	<2		0.6	<500
MAY	1.5	<0.1	0.0	8.7	240	0.0	0.0						
JUNE	1.6	<0.1	2.5	8.3	286	5.3	2.7						
JULY	2.2	<0.1	5.7	8.0	334	1.5	0.8						
AUGUST	1.7	<0.1	7.7	7.7	341	3.3	0.0		<2	3		2.0	<500
SEPTEMBER	1.9	<0.1	3.3	8.2	343	3.0	0.0						
OCTOBER	2.3	<0.1	2.1	8.9	313	2.7	0.0		<3	3		<0.6	<500
NOVEMBER	2.8	<0.1	7.2	10.0	260	1.4	0.0						
DECEMBER	2.2	<0.1	6.0	11.2	189	0.0	0.0						
AVERAGE	1.9	<0.1	4.6	8.9	270	1.5	0.3		<2	2		0.8	<500
MAXIMUM	2.8	<0.1	15.0	11.2	343	5.3	2.7		<3	3		2.0	<500
MINIMUM	1.0	<0.1	0.0	7.2	189	0.0	0.0		<2	<2		<.6	<500

McMILLAN WATER TREATMENT PLANT FINISHED WATER

1992	Chloroform	Bromodichloromethane	Chlorodibromomethane	Bromoform	Total Trihalomethanes	Endrin	Lindane	Methoxychlor	Toxaphene	2,4-D	2,4,5-TP(Silvex)	Benzene	Carbon Tetrachloride	1,2-Dichloroethane	Trichloroethylene	1,4-Dichlorobenzene	1,1-Dichloroethylene	1,1,1-Trichloroethane	Vinyl Chloride
	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
JANUARY	23.9	9.9	1.5	0.0	35	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FEBRUARY	25.3	13.5	3.0	0.0	41	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MARCH	19.5	8.7	1.4	0.0	29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
APRIL	20.2	8.1	1.6	0.0	29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAY	45.4	10.5	1.5	0.0	57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JUNE	47.4	12.7	1.8	0.0	61	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JULY	51.0	14.0	2.4	0.0	67	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AUGUST	100.0	18.0	2.1	0.0	120	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SEPTEMBER	75.6	19.1	2.5	0.0	97	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTOBER	54.7	16.8	2.2	0.0	73	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	ND	ND	ND	ND
NOVEMBER	50.2	9.4	0.6	0.0	60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECEMBER	23.9	8.7	1.3	0.0	33	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVERAGE	44.7	12.4	1.8	0.0	59	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAXIMUM	100.0	19.1	3.0	0.0	120	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	ND	ND	ND	ND
MINIMUM	19.5	8.1	0.6	0.0	29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

1992	Total Organic Carbon	Methylene Blue Active Substances	Chemical Oxygen Demand	Disolved Oxygen	Conductivity	Total Coliform	Fecal Coliform	Algae Count	Gross Alpha	Gross Beta	Radium (226-228)	Strontium-90	Tritium
	mg/l	mg/l	mg/l	mg/l	µmhos/cm	%+	%+	Org./ml	pCi/l	pCi/l	pCi/l	pCi/l	pCi/l
JANUARY	3.0	<0.1	10.0		253	1.6	0.0		<2	2		0.7	<500
FEBRUARY	2.1	<0.1	4.0		282	0.0	0.0						
MARCH	1.5	<0.1	0.0		219	0.0	0.0						
APRIL	2.3	<0.1	6.1		225	0.0	0.0		<2	3		<.5	<500
MAY	1.7	<0.1	0.0		222	0.9	0.9						
JUNE	1.8	<0.1	0.0		264	0.0	0.0						
JULY	2.1	<0.1	8.5		334	0.0	0.0						
AUGUST	2.0	<0.1	4.5		319	3.5	0.0		<2	4		<.6	<500
SEPTEMBER	2.2	<0.1	3.0		333	2.8	1.9						
OCTOBER	2.9	<0.1	2.2		310	0.0	0.0		<2	3		<.6	<500
NOVEMBER	2.0	<0.1	5.0		294	0.0	0.0						
DECEMBER	2.4	<0.1	5.8		215	1.1	1.1						
AVERAGE	2.2	<0.1	4.1		272	0.8	0.3		<2	3		0.6	<500
MAXIMUM	3.0	<0.1	10.0		334	3.5	1.9		<2	4		0.7	<500
MINIMUM	1.5	<0.1	0.0		215	0.0	0.0		<2	2		<.6	<500

ND = Not Detected   * = Less than the Dectection Limit (0.5 ug/l)

LAB Form 648 Rev. March '90'

W.A. Dwg. No. 100.1-4.14-4

F— 12-7-93

WASHINGTON AQUEDUCT DIVISION

U.S. ARMY ENGINEER DISTRICT, BALTIMORE

COMPOSITE ANALYSIS OF WATER

BY DALECARLIA LABORATORY

POTOMAC RIVER RAW WATER SUPPLY

1992	pH	MO Alkalinity as CaCO3	Turbidity	Temperature	Total Solids	Hardness as CaCO3	Chlorine Residual DPD Free	Chloride	Fluoride	Bromide	Phosphate (PO4)	Silicate (SiO2)	Sulfate (SO4)	Nitrate (NO3)	Nitrite (NO2)	Ammonia (NH3)	Aluminum	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Zinc	Beryllium	Antimony	Thallium	Lithium
	mg/l	mg/l	mg/l	°F	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
JANUARY	8.0	78	11.1	40	253	117		22.8	0.12	<0.75	<0.50	9.6	37.0	2.71	<0.25	0.26	0.565	<.002	0.050	<.001	35	<.001	0.004	0.943	<.002	6	0.058	<.0001	0.001	3.53	<.002	<.001	10.2	0.186	0.004	<.001	<.002	<.001	0.003
FEBRUARY	8.2	74	7.0	40	202	126		24.4	0.13	<0.75	<0.50	3.8	30.8	1.47	<0.25	<0.10	0.659	<.002	0.053	<.001	39	<.001	0.003	0.432	0.003	7	0.028	<.0001	0.001	2.41	<.002	<.001	13.8	0.283	0.007	<.001	<.002	<.001	0.005
MARCH	7.7	53	21.7	44	149	92		14.3	0.09	<0.75	<0.50	8.3	31.3	2.11	<0.25	<0.10	0.443	<.002	0.055	<.001	27	<.001	0.002	0.670	<.002	5	0.067	<.0001	0.002	2.22	<.002	<.001	7.0	0135	0.012	<.001	<.002	<.001	0.003
APRIL	7.8	66	22.9	55	163	102		9.1	0.09	<0.75	<0.50	3.8	40.3	1.98	<0.25	<0.10	0.486	<.002	0.034	<.001	30	<.001	<.002	0.613	<.002	6	0.064	<.0001	0.001	2.08	<.002	<.001	6.6	0.142	0.005	<.001	<.002	<.001	0.003
MAY	7.7	67	13.5	62	157	100		***	0.08	<0.75	<0.50	5.4	22.3	1.23	<0.25	<0.10	0.647	<.002	0.056	<.001	31	<.001	0.002	0.521	<.002	4	0.082	<.0001	0.001	2.10	<.002	<.001	7.2	0.159	0.002	<.001	<.002	<.001	0.003
JUNE	7.8	78	13.6	70	174	110		8.7	0.12	<0.75	<0.50	6.6	27.4	1.86	<0.25	<0.10	1.002	<.002	0.052	<.001	34	<.001	0.041	1.159	<.002	5	0.097	<.0001	0.002	2.58	<.002	<.001	7.6	0.171	0.003	<.001	<.002	<.001	0.003
JULY	7.9	89	7.6	78	250	127		6.8	0.11	<0.75	<0.50	5.8	29.7	1.81	<0.25	<0.10	0.358	<.004	0.041	<.001	39	<.002	0.097	0.235	<.002	7	0.032	<.0001	<.002	2.82	<.005	<.002	9.6	0.209	<.002	<.001	<.005	<.005	0.003
AUGUST	8.1	91	8.7	75	79	135		6.9	0.12	<0.75	<0.50	5.0	37.3	1.66	<0.25	<0.10	0.872	<.004	0.047	<.001	40	<.002	0.072	0.958	<.002	8	0.049	<.0001	<.002	3.16	<.005	<.001	7.3	0.190	<.002	<.001	<.005	<.005	0.004
SEPTEMBER	8.0	101	6.4	70	147	140		12.0	0.13	<0.75	<0.50	3.4	26.6	1.78	<0.12	<0.10	0.548	<.004	0.057	<.001	41	<.002	0.077	0.348	<.002	9	0.029	<.0001	<.002	3.16	<.005	<.001	13.6	0.279	0.003	<.001	<.005	<.005	0.005
OCTOBER	8.3	105	7.3	58	249	144		13.9	0.16	<0.75	<0.50	1.2	43.3	1.79	<0.12	<0.10	0.670	<.004	0.044	<.001	42	<.002	0.132	0.401	<.002	9	0.054	<.0001	<.002	4.05	<.005	<.001	12.1	0.195	0.003	<.001	<.005	<.005	0.003
NOVEMBER	7.8	82	19.0	50	208	124		25.4	0.16	<0.75	<0.50	9.7	42.2	2.14	<0.12	<0.10	0.212	<.004	0.067	<.001	37	<.002	0.004	0.272	<.002	7	0.025	<.0001	<.002	3.83	<.005	<.001	16.2	0.292	<.002	<.001	<.005	<.005	0.005
DECEMBER	7.7	62	19.9	40	185	98		9.9	0.10	<0.50	<0.50	7.1	25.1	2.19	<0.12	<0.10	1.021	<.004	0.031	<.001	28	<.002	<.002	0.657	<.002	6	0.062	<.0001	<.002	2.64	<.005	<.001	8.9	0.176	0.008	<.001	<.005	<.005	0.003
AVERAGE	7.9	79	13.2	57	184	118		12.9	0.12	<0.72	<0.50	5.8	32.8	1.89	<0.20	<0.11	0.623	<.003	0.048	<.001	35	<.001	0.036	0.600	<.002	7	0.053	<.0001	0.001	2.88	<.003	<.001	10.0	0.201	0.004	<.001	<.003	<.003	0.003
MAXIMUM	8.3	105	22.9	78	253	144		25.4	0.16	<0.75	<0.50	9.7	43.3	2.71	<0.25	0.26	1.021	<.004	0.067	<.001	42	<.002	0.132	1.159	0.003	9	0.097	<.0001	0.002	4.05	<.005	<.002	16.2	0.292	0.012	<.001	<.005	<.005	0.005
MINIMUM	7.7	53	6.4	40	79	92		6.8	0.08	<0.50	<0.50	1.2	22.3	1.23	<0.12	<0.10	0.212	<.002	0.031	<.001	27	<.001	<.002	0.235	<.002	4	0.025	<.0001	<.001	2.08	<.002	<.001	6.6	0.135	<.002	<.001	<.002	<.001	0.003

DALECARLIA WATER TREATMENT PLANT FINISHED WATER

1992	pH	MO Alkalinity as CaCO3	Turbidity	Temperature	Total Solids	Hardness as CaCO3	Chlorine Residual DPD Free	Chloride	Fluoride	Bromide	Phosphate (PO4)	Silicate (SiO2)	Sulfate (SO4)	Nitrate (NO3)	Nitrite (NO2)	Ammonia (NH3)	Aluminum	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Zinc	Beryllium	Antimony	Thallium	Lithium
	mg/l	mg/l	mg/l	°F	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
JANUARY	8.3	78	0.38	40	248	127	1.3	24.7	0.92	<0.75	<.50	9.8	48.3	2.80	<.25	<.10	0.124	<.002	0.052	<.001	40	<.001	0.002	0.015	0.002	6	0.004	<.0001	<.001	3.40	<.002	<.001	9.9	0.164	0.005	<.001	<.002	<.001	0.003
FEBRUARY	8.4	74	0.30	41	236	137	1.2	26.3	0.92	<0.75	<.50	4.4	59.0	2.15	<.25	<.10	0.092	<.002	0.059	<.001	42	<.001	<.002	0.021	<.002	7	0.002	<.0001	0.001	2.38	<.002	<.001	13.3	0.276	0.005	<.001	<.002	<.001	0.004
MARCH	8.4	55	0.29	45	175	110	1.1	18.2	0.86	<0.75	<.50	6.5	39.4	2.29	<.25	<.10	0.062	<.002	0.049	<.001	35	<.001	<.002	<.010	<.002	5	0.012	<.0001	0.001	2.19	<.002	<.001	7.8	0.153	0.003	<.001	<.002	<.001	0.003
APRIL	8.3	66	0.43	55	173	117	1.2	11.6	0.87	<0.75	<.50	4.8	46.6	1.97	<.25	<.10	0.075	<.002	0.044	<.001	36	<.001	<.002	0.011	<.002	6	0.010	<.0001	<.001	2.02	<.002	<.001	6.6	0.114	0.003	<.001	<.002	<.001	0.002
MAY	8.2	68	0.45	62	174	113	1.4	***	0.85	<0.75	<.50	5.8	32.4	1.24	<.25	<.10	0.055	<.002	0.052	<.001	36	<.001	0.002	<.010	<.002	5	0.003	<.0001	<.001	2.10	<.002	<.001	7.1	0.158	<.002	<.001	<.002	<.001	0.003
JUNE	7.9	78	0.62	69	166	124	1.7	12.9	0.85	<0.75	<.50	6.0	32.1	1.80	<.25	<.10	0.087	<.002	0.052	<.001	39	<.001	0.006	0.015	<.002	6	0.003	<.0001	<.001	2.41	<.002	<.001	7.9	0.196	<.002	<.001	<.002	<.001	0.002
JULY	7.7	90	0.56	76	268	141	1.9	13.5	1.06	<0.75	<.50	5.3	37.8	1.83	<.25	<.10	0.171	<.004	0.042	<.001	42	<.002	0.016	0.013	<.002	8	<.002	<.0001	<.002	2.99	<.005	<.002	9.6	0.216	<.002	<.001	<.005	<.005	0.004
AUGUST	7.8	89	0.51	74	144	143	2.0	12.3	0.89	<0.75	<.50	3.8	46.2	1.68	<.25	<.10	0.065	<.004	0.043	<.001	45	<.002	0.013	0.014	<.002	8	<.002	<.0001	<.002	3.33	<.005	<.001	6.4	0.178	<.002	<.001	<.005	<.005	0.004
SEPTEMBER	7.7	99	0.42	70	138	153	2.1	14.4	0.93	<0.75	<.50	2.4	40.3	1.69	<.12	<.10	0.291	<.004	0.047	<.001	45	<.002	0.014	<.010	<.002	10	<.002	<.0001	<.002	3.08	<.005	<.001	13.7	0.265	<.002	<.001	<.005	<.005	0.004
OCTOBER	7.8	99	0.55	59	239	155	2.0	16.1	0.92	<0.75	<.50	1.2	51.7	1.73	<.12	<.10	0.097	<.004	0.044	<.001	45	<.002	0.016	<.010	<.002	9	<.002	<.0001	<.002	4.24	<.005	<.001	11.4	0.189	<.002	<.001	<.005	<.005	0.003
NOVEMBER	7.9	83	0.39	51	113	144	1.7	21.6	0.92	<0.75	<.50	6.2	42.0	2.20	<.12	<.10	0.133	<.004	0.059	<.001	44	<.002	0.004	<.010	<.002	8	<.002	<.0001	<.002	3.85	<.005	<.001	16.1	0.292	<.002	<.001	<.005	<.005	0.004
DECEMBER	8.4	65	0.36	41	177	114	1.5	12.2	0.90	<0.50	<.50	8.2	34.6	2.22	<.12	<.10	0.090	<.004	0.032	<.001	35	<.002	<.002	0.014	<.002	6	0.002	<.0001	<.002	2.74	<.005	<.001	8.9	0.165	0.003	<.001	<.005	<.005	0.002
AVERAGE	8.1	79	0.44	57	187	131	1.6	15.6	0.91	<0.72	<.50	5.4	42.5	1.97	<.20	<.10	0.111	<.003	0.047	<.001	40	<.001	0.006	0.012	<.002	7	0.003	<.0001	0.001	2.89	<.003	<.001	9.9	0.197	0.002	<.001	<.003	<.003	0.003
MAXIMUM	8.4	99	0.62	76	268	155	2.1	26.3	1.06	<0.75	<.50	9.8	59.0	2.80	<.25	<.10	0.291	<.004	0.059	<.001	45	<.002	0.016	0.021	0.002	10	0.012	<.0001	<.002	4.24	<.005	<.002	16.1	0.292	0.005	<.001	<.005	<.005	0.004
MINIMUM	7.7	55	0.29	40	113	110	1.1	11.6	0.85	<0.50	<.50	1.2	32.1	1.24	<.12	<.10	0.055	<.002	0.032	<.001	35	<.001	<.002	<.010	<.002	5	<.002	<.0001	<.001	2.02	<.002	<.001	6.4	0.114	<.002	<.001	<.002	<.001	0.002

McMILLAN WATER TREATMENT PLANT FINISHED WATER

1992	pH	MO Alkalinity as CaCO3	Turbidity	Temperature	Total Solids	Hardness as CaCO3	Chlorine Residual DPD Free	Chloride	Fluoride	Bromide	Phosphate (PO4)	Silicate (SiO2)	Sulfate (SO4)	Nitrate (NO3)	Nitrite (NO2)	Ammonia (NH3)	Aluminum	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Strontium	Zinc	Beryllium	Antimony	Thallium	Lithium
	mg/l	mg/l	mg/l	°F	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
JANUARY	8.3	76	0.31	48	264	128	1.3	20.7	0.95	<0.75	<0.50	11.5	45.8	2.56	<0.25	<0.10	0.108	<.002	0.054	<.001	39	<.001	0.005	<.010	0.002	6	0.010	<.0001	0.001	2.88	<.002	<.001	12.1	0.233	0.007	<.001	<.002	<.001	0.004
FEBRUARY	8.3	78	0.26	45	225	136	1.2	26.8	1.14	<0.75	<0.50	2.9	59.3	2.31	<0.25	<0.10	0.038	<.002	0.062	<.001	43	<.001	0.007	0.100	<.002	6	<.002	<.0001	0.002	2.46	<.002	<.001	13.3	0.251	0.003	<.001	<.002	<.001	0.004
MARCH	8.4	50	0.18	48	162	107	1.1	15.3	0.79	<0.75	<0.50	5.9	41.7	2.34	<0.25	<0.10	0.060	<.002	0.056	<.001	33	<.001	0.005	0.014	<.002	5	0.003	<.0001	<.001	2.52	<.002	<.001	11.6	0.159	0.005	<.001	<.002	<.001	0.003
APRIL	8.3	62	0.34	53	180	109	1.2	9.8	0.85	<0.75	<0.50	4.9	44.7	2.09	<0.25	<0.10	0.045	<.002	0.061	<.001	34	<.001	0.003	<.010	<.002	5	<.002	<.0001	<.001	2.26	<.002	0.001	7.8	0.128	0.003	<.001	<.002	<.001	0.003
MAY	8.1	60	0.41	60	166	108	1.4	***	0.89	<0.75	<0.50	6.1	30.4	1.47	<0.25	<0.10	0.052	<.002	0.049	<.001	35	<.001	0.006	0.010	<.002	5	<.002	<.0001	0.001	2.41	<.002	<.001	5.7	0.139	<.002	<.001	<.002	<.001	0.003
JUNE	7.9	72	0.51	67	251	119	1.7	11.1	0.84	<0.75	<0.50	6.6	33.2	1.58	<0.25	<0.10	0.095	<.002	0.055	<.001	36	<.001	0.047	0.052	<.002	6	0.005	<.0001	<.001	2.15	<.002	<.001	7.2	0.187	<.002	<.001	<.002	<.001	0.002
JULY	7.7	86	0.87	74	245	140	2.0	15.6	0.93	<0.75	<0.50	5.4	38.8	1.78	<0.25	<0.10	0.171	<.004	0.038	<.001	43	<.002	0.067	<.010	<.002	7	<.002	<.0001	<.002	2.57	<.005	<.002	9.5	0.206	<.002	<.001	<.005	<.005	0.003
AUGUST	7.7	81	0.68	75	142	142	2.1	10.7	0.79	<0.75	<0.50	5.0	42.5	1.56	<0.25	<0.10	0.091	<.004	0.045	<.001	43	<.002	0.126	0.013	<.002	8	<.002	<.0001	<.002	3.67	<.005	<.001	8.5	0.200	<.002	<.001	<.005	<.005	0.003
SEPTEMBER	7.7	96	0.58	74	144	153	2.2	13.7	0.99	<0.75	<0.50	2.1	39.0	1.40	<0.12	<0.10	0.370	<.004	0.050	<.001	45	<.002	0.123	0.012	<.002	9	0.008	<.0001	<.002	2.94	<.005	<.001	12.1	0.253	0.003	<.001	<.005	<.005	0.004
OCTOBER	7.8	93	0.60	66	229	147	2.0	15.0	0.97	<0.75	<0.50	1.8	42.0	1.61	<0.12	<0.10	0.112	<.004	0.045	<.001	43	<.002	0.097	<.010	<.002	8	<.002	<.0001	<.002	3.47	<.005	<.001	10.9	0.197	<.002	<.001	<.005	<.005	0.003
NOVEMBER	8.0	83	0.37	58	221	144	1.8	27.7	0.91	<0.75	<0.50	3.2	42.2	1.75	<0.12	<0.10	0.139	<.004	0.055	<.001	44	<.002	0.022	<.010	<.002	8	<.002	<.0001	<.002	3.66	<.005	<.001	15.8	0.276	<.002	<.001	<.005	<.005	0.004
DECEMBER	8.4	59	0.28	50	178	113	1.7	15.2	0.84	<0.50	<0.50	7.3	41.9	2.64	<0.12	<0.10	0.082	<.004	0.034	<.001	34	<.002	0.012	<.010	<.002	6	0.003	<.0001	<.002	3.99	<.005	<.001	8.8	0.148	0.003	<.001	<.005	<.005	0.003
AVERAGE	8.1	75	0.45	60	200	129	1.6	15.7	0.91	<0.72	<0.50	5.2	40.2	1.93	<0.20	<0.10	0.113	<.003	0.050	<.001	39	<.001	0.043	0.021	<.002	7	0.003	<.0001	0.001	2.91	<.003	<.001	10.3	0.198	0.003	<.001	<.003	<.003	0.003
MAXIMUM	8.4	96	0.87	75	264	153	2.2	27.7	1.14	<0.75	<0.50	11.5	59.3	2.64	<0.25	<0.10	0.370	<.004	0.062	<.001	45	<.002	0.126	0.100	0.002	9	0.010	<.0001	0.002	3.99	<.005	<.002	15.8	0.276	0.007	<.001	<.005	<.005	0.004
MINIMUM	7.7	50	0.18	45	142	107	1.1	9.8	0.79	<0.50	<0.50	1.8	30.4	1.40	<0.12	<0.10	0.038	<.002	0.034	<.001	33	<.001	0.003	<.010	<.002	5	<.002	<.0001	<.001	2.15	<.002	<.001	5.7	0.128	<.002	<.001	<.002	<.001	0.002

*** = No Data

W.A. Dwg. No. 100.1-4.14-6

NAB Form 648 Rev. March "90"

WASHINGTON AQUEDUCT DIVISION

U.S. ARMY ENGINEER DISTRICT, BALTIMORE

COMPOSITE ANALYSIS OF WATER

BY DALECARLIA LABORATORY

POTOMAC RIVER RAW WATER SUPPLY

1992	Bromobenzene	Bromochloromethane	Bromomethane	tert-Butylbenzene	sec-Butylbenzene	n-Butylbenzene	Chlorobenzene	Chloroethane	Chloromethane	2-Chlorotoluene	4-Chlorotoluene	1,2-DiBr-3-Clpropane(DBCP)	1,2-Dibromoethane(EDB)	Dibromomethane	1,3-Dichlorobenzene	1,2-Dichlorobenzene	Dichlorodifluoromethane	1,1-Dichloroethane	trans-1,2-Dichloroethylene	cis-1,2-Dichloroethylene	1,3-Dichloropropane	2,2-Dichloropropane	1,2-Dichloropropane	trans-1,3-Dichloropropene
	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
JANUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FEBRUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MARCH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
APRIL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JUNE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JULY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AUGUST	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SEPTEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTOBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NOVEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVERAGE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAXIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MINIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

1992	cis-1,3-Dichloropropene	1,1-Dichloropropene	Ethylbenzene	Hexachlorobutadiene	Isopropylbenzene	p-Isopropyltoluene	Methylene Chloride	Napthalene	n-Propylbenzene	Styrene	1,1,1,2-Tetrachloroethane	1,1,2,2-Tetrachloroethane	Tetrachloroethylene	Toluene	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,1,2-Trichloroethane	Trichlorofluoromethane	1,2,3-Trichloropropane	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	m & p-Xylene	o-Xylene
	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
JANUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FEBRUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND
MARCH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
APRIL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JUNE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JULY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AUGUST	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SEPTEMBER	ND	ND	*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	ND	ND	ND	ND	ND	*	ND
OCTOBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NOVEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVERAGE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAXIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND	ND	ND	ND	ND	*	*	ND
MINIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

DALECARLIA WATER TREATMENT PLANT FINISHED WATER

1992	Bromobenzene	Bromochloromethane	Bromomethane	tert-Butylbenzene	sec-Butylbenzene	n-Butylbenzene	Chlorobenzene	Chloroethane	Chloromethane	2-Chlorotoluene	4-Chlorotoluene	1,2-DiBr-3-Clpropane(DBCP)	1,2-Dibromoethane(EDB)	Dibromomethane	1,3-Dichlorobenzene	1,2-Dichlorobenzene	Dichlorodifluoromethane	1,1-Dichloroethane	trans-1,2-Dichloroethylene	cis-1,2-Dichloroethylene	1,3-Dichloropropane	2,2-Dichloropropane	1,2-Dichloropropane	trans-1,3-Dichloropropene
	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
JANUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FEBRUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MARCH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
APRIL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JUNE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JULY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AUGUST	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SEPTEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTOBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NOVEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVERAGE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAXIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MINIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

1992	cis-1,3-Dichloropropene	1,1-Dichloropropene	Ethylbenzene	Hexachlorobutadiene	Isopropylbenzene	p-Isopropyltoluene	Methylene Chloride	Napthalene	n-Propylbenzene	Styrene	1,1,1,2-Tetrachloroethane	1,1,2,2-Tetrachloroethane	Tetrachloroethylene	Toluene	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,1,2-Trichloroethane	Trichlorofluoromethane	1,2,3-Trichloropropane	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	m & p-Xylene	o-Xylene
	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
JANUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FEBRUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MARCH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
APRIL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JUNE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JULY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AUGUST	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SEPTEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTOBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NOVEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVERAGE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAXIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MINIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

McMILLAM WATER TREATMENT PLANT FINISHED WATER

1992	Bromobenzene	Bromochloromethane	Bromomethane	tert-Butylbenzene	sec-Butylbenzene	n-Butylbenzene	Chlorobenzene	Chloroethane	Chloromethane	2-Chlorotoluene	4-Chlorotoluene	1,2-DiBr-3-Clpropane(DBCP)	1,2-Dibromoethane(EDB)	Dibromomethane	1,3-Dichlorobenzene	1,2-Dichlorobenzene	Dichlorodifluoromethane	1,1-Dichloroethane	trans-1,2-Dichloroethylene	cis-1,2-Dichloroethylene	1,3-Dichloropropane	2,2-Dichloropropane	1,2-Dichloropropane	trans-1,3-Dichloropropene
	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
JANUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FEBRUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MARCH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
APRIL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JUNE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JULY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AUGUST	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SEPTEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTOBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NOVEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVERAGE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAXIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MINIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

1992	cis-1,3-Dichloropropene	1,1-Dichloropropene	Ethylbenzene	Hexachlorobutadiene	Isopropylbenzene	p-Isopropyltoluene	Methylene Chloride	Napthalene	n-Propylbenzene	Styrene	1,1,1,2-Tetrachloroethane	1,1,2,2-Tetrachloroethane	Tetrachloroethylene	Toluene	1,2,3-Trichlorobenzene	1,2,4-Trichlorobenzene	1,1,2-Trichloroethane	Trichlorofluoromethane	1,2,3-Trichloropropane	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	m & p-Xylene	o-Xylene
	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
JANUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FEBRUARY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND
MARCH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
APRIL	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JUNE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
JULY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AUGUST	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SEPTEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
OCTOBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NOVEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DECEMBER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
AVERAGE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MAXIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	*	ND	ND
MINIMUM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

* = Detected but not Quantified (Less than detection limit of 0.5 ug/l)

NAB Form 648 Rev. March '90

W.A. Dwg. No. 100.1-4.14-6

Revised 2/18/93

POTOMAC WATER FILTRATION PLANT
TAP WATER ANALYSIS - 1992

PARAMETER	UNIT OF MEASURE	YEARLY AVERAGE	MAXIMUM MONTHLY AVERAGE	MINIMUM MONTHLY AVERAGE	EPA LIMIT
PHYSICAL					
Alkalinity	mg/L*	66	87	44	
Color	Units	0	1	0	
Dissolved Solids, Total	mg/L	221	263	188	
Hardness	mg/L	130	150	113	
pH	Units	7.5	7.8	7.3	
Specific Conductance	µSiemens* @25°C	321	381	272	
Temperature	°C	14.7	27.7	5.7	
Threshold Odor	Units	1.3	1.5	1.0	
Turbidity	NTU*	0.17	0.22	0.13	1.0
METALS					
Aluminum	mg/L	0.028	0.055	0.012	
Arsenic	mg/L	0.000	0.001	0.000	0.05
Barium	mg/L	0.025	0.045	0.016	2.0
Cadmium	mg/L	0.000	0.002	0.000	0.005
Calcium	mg/L	39.1	44.8	33.8	
Chromium	mg/L	0.002	0.004	0.000	0.10
Copper	mg/L	0.033	0.048	0.018	1.3
Iron	mg/L	0.031	0.070	0.015	
Lead	mg/L	0.000	0.000	0.000	0.015
Magnesium	mg/L	7.7	9.0	6.2	
Manganese	mg/L	0.004	0.006	0.002	
Mercury	mg/L	0.0000	0.0000	0.0000	0.002
Potassium	mg/L	3.0	4.0	2.3	
Selenium	mg/L	0.0002	0.0008	0.0000	0.05
Silicon	mg/L	2.6	3.8	1.4	
Silver	mg/L	0.001	0.003	0.000	
Sodium	mg/L	10.0	15.1	6.9	
Zinc	mg/L	0.003	0.007	0.000	
INORGANICS					
Boron	mg/L	0.020	0.040	0.007	
Carbon Dioxide	mg/L	2.1	2.4	1.8	
Chloride	mg/L	33.9	44.8	24.7	
Chlorine	mg/L	3.1	3.7	2.9	
Dissolved Oxygen	mg/L	9.7	12.5	5.8	
Fluoride	mg/L	0.88	0.96	0.71	4.0
Nitrate as Nitrogen	mg/L	2.02	2.68	1.55	10.0
Nitrite as Nitrogen	mg/L	0.014	0.045	0.000	1.0
Phosphorous	mg/L	0.03	0.05	0.00	
Sulfate	mg/L	33.2	50.0	14.3	
BACTERIOLOGICAL (DISTRIBUTION SYSTEM)					
% of Samples Total Coliform Positive		0.41	1.74	0.00	5
ORGANICS					
Organic Carbon, Total	mg/L	2.49	3.35	1.20	
Trihalomethanes, Total	µg/L*	67.5	99.4	37.3	100 **
PESTICIDES					
Endrin	µg/L	0.00	0.00	0.00	2
Lindane	µg/L	0.0	0.0	0.0	0.2
Methoxychlor	µg/L	0.00	0.00	0.00	40
Toxaphene	µg/L	0.0	0.0	0.0	3.0
2,4-D	µg/L	0.87	5.34	0.00	70
2,4,5 TP Silvex	µg/L	0.000	0.000	0.000	50

NOTES: * NTU = Nephelometric Turbidity Units
mg/L = Milligrams per Liter (equals parts per million)
°C = Degrees Celcius
µg/L = Micrograms per Liter (equals parts per billion)
µSiemens = Microsiemens
** Total THM limit based on yearly average in the distribution system

CONTINUED ON BACK

Revised 2/18/93

POTOMAC WATER FILTRATION PLANT
TAP WATER ANALYSIS - 1992 - *CONTINUED*

PARAMETER	UNIT OF MEASURE	YEARLY AVERAGE	MAXIMUM MONTHLY AVERAGE	MINIMUM MONTHLY AVERAGE	EPA LIMIT
VOLATILE ORGANIC CONTAMINANTS					
Benzene	μg/L*	ND ***	ND	ND	5
Carbon Tetrachloride	μg/L	0.0	0.2	ND	5
p-Dichlorobenzene	μg/L	0.0	0.2	ND	75
1,1-Dichloroethene	μg/L	ND	0.1	ND	7
1,2-Dichloroethane	μg/L	ND	ND	ND	5
1,1,1-Trichloroethane	μg/L	0.0	0.2	ND	200
Trichloroethylene	μg/L	0.0	0.2	ND	5
Vinyl Chloride	μg/L	ND	ND	ND	2
trans-1,2-Dichloroethene	μg/L	ND	ND	ND	100
cis-1,2-Dichloroethene	μg/L	ND	ND	ND	70
o-Dichlorobenzene	μg/L	0.0	0.2	ND	600
1,2-Dichloropropane	μg/L	ND	ND	ND	5
Tetrachloroethylene	μg/L	0.0	0.2	ND	5
Chlorobenzene	μg/L	0.0	0.2	ND	100
Toluene	μg/L	0.0	0.3	ND	1000
Ethylbenzene	μg/L	0.0	0.3	ND	700
Total Xylenes	μg/L	ND	ND	ND	10000
Styrene	μg/L	ND	ND	ND	100
Bromobenzene	μg/L	ND	ND	ND	
Bromochloromethane	μg/L	0.0	0.2	ND	
Bromomethane	μg/L	0.0	0.1	ND	
n-Butylbenzene	μg/L	ND	ND	ND	
s-Butylbenzene	μg/L	ND	ND	ND	
t-Butylbenzene	μg/L	ND	ND	ND	
Chloroethane	μg/L	ND	ND	ND	
Chloromethane	μg/L	ND	ND	ND	
2-Chlorotoluene	μg/L	ND	ND	ND	
4-Chlorotoluene	μg/L	ND	ND	ND	
Dibromomethane	μg/L	0.6	1.4	ND	
1,2-Dibromoethane (EDB)	μg/L	ND	ND	ND	
1,2-Dibrom-3-chlorpropane	μg/L	ND	ND	ND	
1,3-Dichlorobenzene	μg/L	0.0	0.3	ND	
Dichlorodifluoromethane	μg/L	0.0	0.1	ND	
1,1-Dichloroethane	μg/L	ND	ND	ND	
Dichloromethane	μg/L	0.1	0.4	ND	
1,3-Dichloropropane	μg/L	ND	ND	ND	
1,1-Dichloropropene	μg/L	ND	ND	ND	
cis-1,3-Dichloropropene	μg/L	ND	ND	ND	
trans-1,3-Dichloropropene	μg/L	ND	ND	ND	
2,2-Dichloropropane	μg/L	ND	ND	ND	
Hexachlorobutadiene	μg/L	ND	ND	ND	
Isopropylbenzene	μg/L	ND	ND	ND	
p-Isopropyltoluene	μg/L	ND	ND	ND	
Naphthalene	μg/L	ND	ND	ND	
n-Propylbenzene	μg/L	ND	ND	ND	
1,1,1,2-Tetrachloroethane	μg/L	ND	ND	ND	
1,1,2,2-Tetrachloroethane	μg/L	ND	ND	ND	
1,2,3-Trichlorobenzene	μg/L	ND	ND	ND	
1,2,4-Trichlorobenzene	μg/L	ND	ND	ND	
1,1,2-Trichloroethane	μg/L	ND	ND	ND	
Trichlorofluoromethane	μg/L	ND	ND	ND	
1,2,3-Trichloropropane	μg/L	ND	ND	ND	
1,2,4-Trimethylbenzene	μg/L	0.0	0.2	ND	
1,3,5-Trimethylbenzene	μg/L	0.1	0.3	ND	

NOTES: * μg/L = Micrograms per Liter (equals parts per billion)
*** ND = Not Detected

Revised 2/18/93

PATUXENT WATER FILTRATION PLANT
TAP WATER ANALYSIS - 1992

PARAMETER	UNIT OF MEASURE	YEARLY AVERAGE	MAXIMUM MONTHLY AVERAGE	MINIMUM MONTHLY AVERAGE	EPA LIMIT
PHYSICAL					
Alkalinity	mg/L*	34	39	29	
Color	Units	0	0	0	
Dissolved Solids, Total	mg/L	111	122	96	
Hardness	mg/L	55	61	50	
pH	Units	8.1	8.5	7.6	
Specific Conductance	μSiemens* @25 °C	160	177	139	
Temperature	°C	15.1	25.0	5.8	
Threshold Odor	Units	1.2	1.4	1.1	
Turbidity	NTU*	0.14	0.21	0.08	1.0
METALS					
Aluminum	mg/L	0.036	0.063	0.027	
Arsenic	mg/L	0.000	0.001	0.000	0.05
Barium	mg/L	0.017	0.027	0.008	2.0
Cadmium	mg/L	0.000	0.002	0.000	0.005
Calcium	mg/L	16.2	20.2	13.2	
Chromium	mg/L	0.002	0.004	0.000	0.10
Copper	mg/L	0.036	0.103	0.010	1.3
Iron	mg/L	0.007	0.014	0.004	
Lead	mg/L	0.000	0.001	0.000	0.015
Magnesium	mg/L	3.6	3.7	3.4	
Manganese	mg/L	0.003	0.005	0.001	
Mercury	mg/L	0.0000	0.0000	0.0000	0.002
Potassium	mg/L	2.6	3.2	2.3	
Selenium	mg/L	0.0002	0.0008	0.0000	0.05
Silicon	mg/L	1.7	2.4	1.2	
Silver	mg/L	0.001	0.002	0.000	
Sodium	mg/L	6.1	6.4	5.5	
Zinc	mg/L	0.002	0.004	0.000	
INORGANICS					
Boron	mg/L	0.008	0.026	0.000	
Carbon Dioxide	mg/L	0.9	1.3	0.7	
Chloride	mg/L	13.7	18.6	8.8	
Chlorine	mg/L	1.6	2.1	1.4	
Dissolved Oxygen	mg/L	8.7	12.7	4.6	
Fluoride	mg/L	0.82	0.95	0.69	4.0
Nitrate as Nitrogen	mg/L	0.81	1.17	0.58	10.0
Nitrite as Nitrogen	mg/L	0.014	0.060	0.000	1.0
Phosphorous	mg/L	0.02	0.07	0.00	
Sulfate	mg/L	12.5	14.9	9.2	
BACTERIOLOGICAL (DISTRIBUTION SYSTEM)					
% of Samples Total Coliform Positive		0.41	1.74	0.00	5
ORGANICS					
Organic Carbon, Total	mg/L	1.66	1.98	0.89	
Trihalomethanes, Total	μg/L*	67.5	99.4	37.3	100 **
PESTICIDES					
Endrin	μg/L	0.00	0.00	0.00	2
Lindane	μg/L	0.0	0.0	0.0	0.2
Methoxychlor	μg/L	0.00	0.00	0.00	40
Toxaphene	μg/L	0.0	0.0	0.0	3.0
2,4-D	μg/L	1.36	6.80	0.00	70
2,4,5 TP Silvex	μg/L	0.000	1.000	0.000	50

NOTES: * NTU = Nephelometric Turbidity Units
mg/L = Milligrams per Liter (equals parts per million)
°C = Degrees Celcius
μg/L = Micrograms per Liter (equals parts per billion)
μSiemens = Microsiemens
** Total THM limit based on yearly average in the distribution system

CONTINUED ON BACK

Revised 2/18/93

PATUXENT WATER FILTRATION PLANT
TAP WATER ANALYSIS - 1992 - *CONTINUED*

PARAMETER	UNIT OF MEASURE	YEARLY AVERAGE	MAXIMUM MONTHLY AVERAGE	MINIMUM MONTHLY AVERAGE	EPA LIMIT
VOLATILE ORGANIC CONTAMINANTS					
Benzene	μg/L*	ND ***	ND	ND	5
Carbon Tetrachloride	μg/L	0.1	0.6	ND	5
p-Dichlorobenzene	μg/L	ND	ND	ND	75
1,1-Dichloroethene	μg/L	ND	ND	ND	7
1,2-Dichloroethane	μg/L	ND	ND	ND	5
1,1,1-Trichloroethane	μg/L	ND	ND	ND	200
Trichloroethylene	μg/L	ND	ND	ND	5
Vinyl Chloride	μg/L	ND	ND	ND	2
trans-1,2-Dichloroethene	μg/L	ND	ND	ND	100
cis-1,2-Dichloroethene	μg/L	ND	ND	ND	70
o-Dichlorobenzene	μg/L	ND	ND	ND	600
1,2-Dichloropropane	μg/L	ND	ND	ND	5
Tetrachloroethylene	μg/L	2.0	23.4	ND	5
Chlorobenzene	μg/L	ND	ND	ND	100
Toluene	μg/L	ND	ND	ND	1000
Ethylbenzene	μg/L	ND	ND	ND	700
Total Xylenes	μg/L	0.0	0.1	ND	10000
Styrene	μg/L	ND	ND	ND	100
Bromobenzene	μg/L	ND	ND	ND	
Bromochloromethane	μg/L	ND	ND	ND	
Bromomethane	μg/L	ND	ND	ND	
n-Butylbenzene	μg/L	ND	ND	ND	
s-Butylbenzene	μg/L	ND	ND	ND	
t-Butylbenzene	μg/L	0.0	0.2	ND	
Chloroethane	μg/L	ND	ND	ND	
Chloromethane	μg/L	ND	ND	ND	
2-Chlorotoluene	μg/L	ND	ND	ND	
4-Chlorotoluene	μg/L	ND	ND	ND	
Dibromomethane	μg/L	0.1	0.6	ND	
1,2-Dibromoethane (EDB)	μg/L	ND	ND	ND	
1,2-Dibrom-3-chlorpropane	μg/L	ND	ND	ND	
1,3-Dichlorobenzene	μg/L	ND	ND	ND	
Dichlorodifluoromethane	μg/L	ND	ND	ND	
1,1-Dichloroethane	μg/L	ND	ND	ND	
Dichloromethane	μg/L	0.2	1.7	ND	
1,3-Dichloropropane	μg/L	ND	ND	ND	
1,1-Dichloropropene	μg/L	ND	ND	ND	
cis-1,3-Dichloropropene	μg/L	ND	ND	ND	
trans-1,3-Dichloropropene	μg/L	ND	ND	ND	
2,2-Dichloropropane	μg/L	ND	ND	ND	
Hexachlorobutadiene	μg/L	ND	ND	ND	
Isopropylbenzene	μg/L	ND	ND	ND	
p-Isopropyltoluene	μg/L	ND	ND	ND	
Naphthalene	μg/L	ND	ND	ND	
n-Propylbenzene	μg/L	ND	ND	ND	
1,1,1,2-Tetrachloroethane	μg/L	ND	ND	ND	
1,1,2,2-Tetrachloroethane	μg/L	ND	ND	ND	
1,2,3-Trichlorobenzene	μg/L	0.0	0.1	ND	
1,2,4-Trichlorobenzene	μg/L	ND	ND	ND	
1,1,2-Trichloroethane	μg/L	ND	ND	ND	
Trichlorofluoromethane	μg/L	ND	0.4	ND	
1,2,3-Trichloropropane	μg/L	ND	ND	ND	
1,2,4-Trimethylbenzene	μg/L	0.0	0.3	ND	
1,3,5-Trimethylbenzene	μg/L	0.1	0.3	ND	

NOTES: * μg/L = Micrograms per Liter (equals parts per billion)
*** ND = Not Detected

SUMMARY TABLE 1 ANDREWS AFB TOTAL COLIFORM AND CHLORINE TEST RESULTS BY LOCATION

Sample Location	Sample I.D.	Sampling Events	Positive Coliform	Positive Chlorine
Bldg. 1889 NCO Club	1	1	0	
Hangar 2, Bldg. 1794	2	48	8	7
Hangar 2, Water Truck 80	2A	1	0	
Hangar 2, Water Truck 97	2B	2	0	
1535 BEE	3	34	2	2
Bldg. 1050 MGMC	4	52	8	7
4636 Poplar Ct.	5	0	0	
Bldg. 2086-A Havord Ave.	6	2	0	
5136-A Jerstad Ct.	7	43	5	4
Bldg. 2137	8	1	1	1
Hangar 8, Bldg. 1225	9	45	10	9
Hangar 8, Watering Truck	9A	2	0	
AF 1	10	6	2	0
4003	11	0	0	
113th Headquarters	12	52	9	1
Bldg. 3575 BEE Lab	13	10	0	
3780-5 Louisiana Ave. Hsg.	14	30	9	8
3780-3 Louisiana Ave. Hsg.	14A	9	2	2
3780-6 Louisiana Ave. Hsg.	14B	1	0	
Bldg. 3763 Dining Hall	15	46	4	3
Bldg. 4782	16	2	2	0
Bldg. 4753	17	2	1	1
Bldg. 4700 Youth Center	18	55	3	2
Bldg. 4079	19	1	1	1
Bldg. 4027	20	0	0	
Bldg. 4014	21	0	0	
Bldg. 4272	22	1	0	

SUMMARY TABLE 1 (Cont.)

Sample Location	Sample I.D.	Sampling Events	Positive Coliform	Positive Chlorine
Bldg. 4575 Child Dev. Center	23	48	4	0
Hangar 10 East Side Sink	36	1	0	
Watering Truck 47	37	2	0	
Watering Truck 94	38	2	0	
#1 Cooling Tower-O Club	61	1	1	1
Alt. Water Point	40	1	0	
Bldg. 1558 Power Prod.	41	1	0	
Base Housing Bldg. 4792	42	5	4	4
Inside	42A	1	1	1
Outside	42B	1	1	1
Base Housing Bldg. 4793	43	2	0	
Base Housing Bldg. 40854	44	3	2	2
Inside	44A	1	1	1
Outside	44B	1	0	
Bldg. 4087	45	2	0	
Bldg. 4613	46	3	1	1
Bldg. 4744	47	2	1	1
Bldg. 4763	48	3	2	2
Bldg. 1836 Reservoir	49	1	1	1
Outlet	49A	24	4	4
Inlet	49B	26	8	8
Bldg. 4022	50	2	0	
Bldg. 2021	51	1	0	
Bldg. 3786	52	1	0	
315 Topeka	53	1	00	
Bldg. 4671	54	1	0	
Bldg. 4006	55	1	0	

SUMMARY TABLE 1 (Cont.)

Sample Location	Sample I.D.	Sampling Events	Positive Coliform	Positive Chlorine
Pres. Maint. East Side	56	1	0	
Pres. Maint. West Side	57	1	0	
Bldg. 1306 Vanderberg	58	1	0	
Water Kit #1	59	1	0	
Water Kit #2	60	1	0	
Navy Chow Hall	61	2	0	
WSSC Vualt West Pipe	62	2	0	
Bldg. 4614 West Tower	63	3	1	1
East Tower	64	4	2	2

SUMMARY TABLE 2 ANDREWS AFB TOTAL COLIFORM AND CHLORINE TEST RESULTS BY TIME

Date of Sampling	Sampling Events	Positive Coliform	Positive Chlorine
01/13/93	9	0	
02/03/93	2	0	
02/10/93	1	0	
02/17/93	3	0	
02/24/93	3	0	
02/25/93	3	0	
03/01/93	5	2	2
03/02/93	6	3	3
03/04/93	4	2	2
03/05/93	7	6	6
03/06/93	11	6	5
03/07/93	23	6	5
03/09/93	10	0	0
03/10/93	0	0	0
03/11/93	9	1	1
03/12/93	5	0	
03/17/93	10	2	2
03/18/93	12	4	4
03/23/93	8	2	2
03/25/93	8	1	1
03/30/93	10	3	3
04/08/93	12	0	
04/13/93	12	0	
04/15/93	1	1	1
04/20/93	11	1	1
04/21/93	4	0	
04/27/93	24	7	7
05/05/93	4	0	

SUMMARY TABLE 2 (Cont.)

Date of Sampling	Sampling Events	Positive Coliform	Positive Chlorine
05/07/93	0	0	
05/08/93	0	0	
05/09/93	0	0	
05/10/93	0	0	
05/11/93	0	0	
05/12/93	20	0	
05/13/93	0	0	
05/19/93	22	4	2
05/26/93	20	4	1
06/02/93	24	4	2
06/09/93	24	1	0
06/16/93	10	0	
06/17/93	13	1	0
06/22/93	2	0	
06/24/93	26	3	2
06/30/93	20	5	4
07/07/93	20	1	1
07/14/93	22	0	
07/15/93	20	12	5
07/20/93	20	9	6
07/23/93	20	3	2
07/29/93	22	0	
08/04/93	18	1	1
08/05/93	2	2	2
08/11/93	16	0	
08/13/93	0	0	
08/15/93	0	0	
08/18/93	24	1	1
08/25/93	20	6	4

ANDREWS AIR FORCE BASE
Total Coliform Test Results 1/13/93 - 3/2/93

Location	I.D.	Sampling Events	Positive Coliform	Positive Chlorine	1-13-93	2-3-93	2-10-93	2-17-93	2-24-93	2-25-93	3-01-93	3-02-93
Bldg. 1889 NCO Club	1	1	0									
Hangar 2, Bldg. 1794	2	48	8	7								
Hangar 2, Water Truck 80	2A	1	0									
Hangar 2, Water Truck 97	2B	2	0					-				
1535 BEE	3	34	2	2								
Bldg. 1050 MGMC	4	52	8	7	-		-					
4636 Poplar Ct.	5	0	0									
Bldg. 2086-A Havord Ave.	6	2	0									
5136-A Jerstad Ct.	7	43	5	4				-				
Bldg. 2137	8	1	1	1								
Hangar 8, Bldg. 1225	9	45	10	9	-				-			
Hangar 8, Watering Truck	9A	2	0									
AF 1	10	6	2	0	-							
4003	11	0	0									
113th Headquarters	12	52	9	1		-					-	
Bldg. 3575 BEE Lab	13	10	0			-					-	
3780-5 Louisiana Ave. Hsg.	14	30	9	8								
3780-3 Louisiana Ave. Hsg.	14A	9	2	2	-		-					
3780-6 Louisiana Ave. Hsg.	14B	1	0									
Bldg. 3763 Dining Hall	15	46	4	3	-				-			
Bldg. 4782	16	2	2	0								
Bldg. 4753	17	2	1	1								
Bldg. 4700 Youth Center	18	55	3	2	-				-		-	-
Bldg. 4079	19	1	1	1								
Bldg. 4027	20	0	0									
Bldg. 4014	21	0	0									
Bldg. 4272	22	1	0									
Bldg. 4575 Child Dev. Center	23	48	4	0	-							
Hangar 10 East Side Sink	36	1	0									
Watering Truck 47	37	2	0									
Watering Truck 94	38	2	0									
#1 Cooling Tower-O Club	61	1	1	1								
Alt. Water Point	40	1	0		-							
Bldg. 1558 Power Prod.	41	1	0		-							
Base Housing Bldg. 4792	42	5	4	4							*	
Inside	42A	1	1	1								*
Outside	42B	1	1	1								*

(-) Negative Coliform
(+) Positive Coliform
[redacted]ositive[redacted]orm &[redacted]ine [redacted]

ANDREWS AIR FORCE BASE
Total Coliform Test Results 1/13/93 - 3/2/93

Location	I.D.	Sampling Events	Positive Coliform	Positive Chlorine	1-13-93	2-3-93	2-10-93	2-17-93	2-24-93	2-25-93	3-01-93	3-02-93
Base Housing Bldg. 4793	43	2	0									-
Base Housing Bldg. 40854	44	3	2	2							*	
Inside	44A	1	1	1								*
Outside	44B	1	0									-
Bldg. 4087	45	2	0									
Bldg. 4613	46	3	1	1								
Bldg. 4744	47	2	1	1								
Bldg. 4763	48	3	2	2								
Bldg. 1836 Reservoir	49	1	1	1								
Outlet	49A	24	4	4								
Inlet	49B	26	8	8								
Bldg. 4022	50	2	0									
Bldg. 2021	51	1	0									
Bldg. 3786	52	1	0									
315 Topeka	53	1	00									
Bldg. 4671	54	1	0									
Bldg. 4006	55	1	0									
Pres. Maint. East Side	56	1	0									
Pres. Maint. West Side	57	1	0									
Bldg. 1306 Vanderberg	58	1	0									
Water Kit #1	59	1	0									
Water Kit #2	60	1	0									
Navy Chow Hall	61	2	0									
WSSC Vualt West Pipe	62	2	0									
Bldg. 4614 West Tower	63	3	1	1								
East Tower	64	4	2	2								
Sampler					DBS/CB	FW	FW	FW	JM	JM	SMC	SMC
Events					9	2	1	3	3	3	5	6
Positive Coliform					0	0	0	0	0	0	2	3
Percent Positive Coliform					0	0	0	0	0	0	40	50
Positive Chlorine					0	0	0	0	0	0	2	3
Month					1	2	2	2	2	2	3	3

(-) Negative Coliform
(+) Positive Coliform
(*) Positive Coliform & Chlorine

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 3/4/93 - 3/23/93

Location	I.D.	3-04-93	3-05-93	3-06-93	3-07-93	3-09-93	3-10-93	3-11-93	3-12-93	3-17-93	3-18-93	3-23-93
Bldg. 1889 NCO Club	1				-							
Hangar 2, Bldg. 1794	2				-	-		-		-	-	*
Hangar 2, Water Truck 80	2A											
Hangar 2, Water Truck 97	2B											
1535 BEE	3											
Bldg. 1050 MGMC	4				*	-		-	-	*	*	-
4636 Poplar Ct.	5											
Bldg. 2086-A Havord Ave.	6											
5136-A Jerstad Ct.	7				-					-		
Bldg. 2137	8				*							
Hangar 8, Bldg. 1225	9				-	-		-		-	*	*
Hangar 8, Watering Truck	9A											
AF 1	10											
4003	11											
113th Headquarters	12				-	-		-		-	-	
Bldg 3575 BEE Lab	13					-		-		-	-	-
3780-5 Louisiana Ave. Hsg.	14											
3780-3 Louisiana Ave. Hsg.	14A									*		
3780-6 Louisiana Ave. Hsg.	14B											
Bldg. 3763 Dining Hall	15					-		-			-	
Bldg. 4782	16			+	+							
Bldg. 4753	17		*	-								
Bldg. 4700 Youth Center	18	-	*	-		-		-	-	-	-	-
Bldg. 4079	19			*								
Bldg. 4027	20											
Bldg. 4014	21											
Bldg. 4272	22				-							
Bldg. 4575 Child Dev. Center	23				-	-		-	-		-	-
Hanger 10 East Side Sink	36											
Watering Truck 47	37											
Watering Truck 94	38											
#1 Cooling Tower-O Club	61											
Alt. Water Point	40											
Bldg. 1558 Power Prod.	41											
Base Housing Bldg. 4792	42	*	*	*								
Inside	42A											
Outside	42B											

(-) Negative Coliform
(+) Positive Coliform
[redacted]itive [redacted]m & [redacted]ne [redacted]

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 3/4/93 - 3/23/93

Location	I.D.	3-04-93	3-05-93	3-06-93	3-07-93	3-09-93	3-10-93	3-11-93	3-12-93	3-17-93	3-18-93	3-23-93
Base Housing Bldg. 4793	43	-										
Base Housing Bldg. 40854	44	*										
Inside	44A											
Outside	44B											
Bldg. 4087	45		-	*								
Bldg. 4613	46		*	-	-							
Bldg. 4744	47		-	*								
Bldg. 4763	48		*	*	-							
Bldg. 1836 Reservoir	49		*									
Outlet	49A			-	*	-		-	-	-	*	-
Inlet	49B			-	*	-		*	-	-	*	-
Bldg. 4022	50			-	-							
Bldg. 2021	51				-							
Bldg. 3786	52				-							
315 Topeka	53				-							
Bldg. 4671	54				-							
Bldg. 4006	55				-							
Pres. Maint. East Side	56											
Pres. Maint. West Side	57											
Bldg. 1306 Vanderberg	58				-							
Water Kit #1	59										-	
Water Kit #2	60										-	
Navy Chow Hall	61											
WSSC Vualt West Pipe	62											
Bldg. 4614 West Tower	63											
East Tower	64											
Sampler		SMC	DBS/CB & FW	DBS/CB & FW	FW/DMD & SGS	FW/DMD & CBK	FW	FW	FW	SMC	FW	FW
Events		4	7	11	23	10	0	9	5	10	12	8
Positive Coliform		2	6	6	6	0	0	1	0	2	4	2
Percent Positive Coliform		50	86	55	26	0	-	11	0	20	33	25
Positive Chlorine		2	6	5	5	0	0	1	0	2	4	2
Month		3	3	3	3	3	3	3	3	3	3	3

(-) Negative Coliform
(+) Positive Coliform
(*) Positive Coliform & Chlorine

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 3/25/93 - 5/8/93

Location	I.D.	3-25-93	3-30-93	4-08-93	4-13-93	4-15-93	4-20-93	4-21-93	4-27-93	5-05-93	5-07-93	5-08-93
Bldg. 1889 NCO Club	1											
Hangar 2, Bldg. 1794	2		*	-	-		-		-/-			
Hangar 2, Water Truck 80	2A							-				
Hangar 2, Water Truck 97	2B											
1535 BEE	3				-				-/-	-		
Bldg. 1050 MGMC	4	-	*	-	-		-		*/-			
4636 Poplar Ct.	5											
Bldg. 2086-A Havord Ave.	6											
5136-A Jerstad Ct.	7			-	-		-		*/-			
Bldg. 2137	8											
Hangar 8, Bldg. 1225	9		*	-	-		-		-/-			
Hangar 8, Watering Truck	9A											
AF 1	10											
4003	11											
113th Headquarters	12	-	-	-	-		-		-/-	-		
Bldg. 3575 BEE Lab	13	-	-	-								
3780-5 Louisiana Ave. Hsg.	14											
3780-3 Louisiana Ave. Hsg.	14A			-	-		-		-/*			
3780-6 Louisiana Ave. Hsg.	14B											
Bldg. 3763 Dining Hall	15	-	-	-	-		-		-/*			
Bldg. 4782	16											
Bldg. 4753	17											
Bldg. 4700 Youth Center	18	-	-	-	-		-		-/-			
Bldg. 4079	19											
Bldg. 4027	20											
Bldg. 4014	21											
Bldg. 4272	22											
Bldg. 4575 Child Dev. Center	23	-	-	-	-		-					
Hanger 10 East Side Sink	36							-				
Watering Truck 47	37											
Watering Truck 94	38											
#1 Cooling Tower-O Club	61					*						
Alt. Water Point	40											
Bldg. 1558 Power Prod.	41											
Base Housing Bldg. 4792	42											
Inside	42A											
Outside	42B											

(-) Negative Coliform
(+) Positive Coliform
[redacted]sitive[redacted]orm &[redacted]ine [redacted]

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 3/25/93 - 5/8/93

Location	I.D.	3-25-93	3-30-93	4-08-93	4-13-93	4-15-93	4-20-93	4-21-93	4-27-93	5-05-93	5-07-93	5-08-93
Base Housing Bldg. 4793	43											
Base Housing Bldg. 40854	44											
Inside	44A											
Outside	44B											
Bldg. 4087	45											
Bldg. 4613	46											
Bldg. 4744	47											
Bldg. 4763	48											
Bldg. 1836 Reservoir	49											
Outlet	49A	-	-	-	-		*		*/-	-		
Inlet	49B	*	-	-	-		-		*/*	-		
Bldg. 4022	50											
Bldg. 2021	51											
Bldg. 3786	52											
315 Topeka	53											
Bldg. 4671	54											
Bldg. 4006	55											
Pres. Maint. East Side	56							-				
Pres. Maint. West Side	57							-				
Bldg. 1306 Vanderberg	58											
Water Kit #1	59											
Water Kit #2	60											
Navy Chow Hall	61											
WSSC Vualt West Pipe	62											
Bldg. 4614 West Tower	63											
East Tower	64											
Sampler		FW	FW	BAM	BAM	BAM	BAM	BAM	SMC	BMK	BMK	BMK
Events		8	10	12	12	1	11	4	24	4	0	0
Positive Coliform		1	3	0	0	1	1	0	7	0	0	0
Percent Positive Coliform		13	30	0	0	100	9	0	29	0	-	-
Positive Chlorine		1	3	0	0	1	1	0	7	0	0	0
Month		3	3	4	4	4	4	4	4	5	5	5

(-) Negative Coliform
(+) Positive Coliform
(*) Positive Coliform & Chlorine

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 5/9/93 - 6/17/93

Location	I.D.	5-09-93	5-10-93	5-11-93	5-12-93	5-13-93	5-19-93	5-26-93	6-02-93	6-09-93	6-16-93	6-17-93
Bldg. 1889 NCO Club	1											
Hangar 2, Bldg. 1794	2				-/-		-/-	-/-	-/*	-/-	-	-
Hangar 2, Water Truck 80	2A											
Hangar 2, Water Truck 97	2B											
1535 BEE	3				-/-		-/-		-/-	-/-	-	-
Bldg. 1050 MGMC	4				-/-		-/-	-/*	-/-	-/-	-	-
4636 Poplar Ct.	5											
Bldg. 2086-A Havord Ave.	6											
5136-A Jerstad Ct.	7						-/-	-/-	-/-	-/-		-/-
Bldg. 2137	8											
Hangar 8, Bldg. 1225	9				-/-			-/*	*/-	-/-	-	
Hangar 8, Watering Truck	9A											
AF 1	10						+/+					
4003	11											
113th Headquarters	12				-/-		-/-	+	+/-	-/+	-	+
Bldg. 3575 BEE Lab	13											
3780-5 Louisiana Ave. Hsg.	14				-/-			-/*	-/-	-/-		-/-
3780-3 Louisiana Ave. Hsg.	14A											
3780-6 Louisiana Ave. Hsg.	14B											
Bldg. 3763 Dining Hall	15						-/-	-/-	-/+	-/-	-	-
Bldg. 4782	16											
Bldg. 4753	17											
Bldg. 4700 Youth Center	18				-/-		-/-	-/-	-/-	-/-	-	-
Bldg. 4079	19											
Bldg. 4027	20											
Bldg. 4014	21											
Bldg. 4272	22											
Bldg. 4575 Child Dev. Center	23				-/-		-/-	-/-	-/-	-/-	-	-
Hangar 10 East Side Sink	36											
Watering Truck 47	37						-/-					
Watering Truck 94	38							-/-				
#1 Cooling Tower-O Club	61											
Alt. Water Point	40											
Bldg. 1558 Power Prod.	41											
Base Housing Bldg. 4792	42											
Inside	42A											
Outside	42B											

(-) Negative Coliform
(+) Positive Coliform
([redacted]tive [redacted]m & [redacted]e [redacted]

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 5/9/93 - 6/17/93

Location	I.D.	5-09-93	5-10-93	5-11-93	5-12-93	5-13-93	5-19-93	5-26-93	6-02-93	6-09-93	6-16-93	6-17-93
Bldg. 1889 NCO Club	1											
Hangar 2, Bldg. 1794	2				-/-		-/-	-/-	-/*	-/-	-	-
Hangar 2, Water Truck 80	2A											
Hangar 2, Water Truck 97	2B											
1535 BEE	3						-/-		-/-	-/-	-	-
Bldg. 1050 MGMC	4				-/-		-/-	-/*	-/-	-/-	-	-
4636 Poplar Ct.	5											
Bldg. 2086-A Havord Ave.	6											
5136-A Jerstad Ct.	7						-/-	-/-	-/-	-/-		-/-
Bldg. 2137	8											
Hangar 8, Bldg. 1225	9				-/-			-/*	*/-	-/-	-	
Hangar 8, Watering Truck	9A											
AF 1	10						+/+					
4003	11											
113th Headquarters	12				-/-		-/-	+	+/-	-/+	-	+
Bldg. 3575 BEE Lab	13				-/-							
3780-5 Louisiana Ave. Hsg.	14				-/-			-/*	-/-	-/-		-/-
3780-3 Louisiana Ave. Hsg.	14A											
3780-6 Louisiana Ave. Hsg.	14B											
Bldg. 3763 Dining Hall	15						-/-	-/-	-/+	-/-	-	-
Bldg. 4782	16											
Bldg. 4753	17											
Bldg. 4700 Youth Center	18				-/-		-/-	-/-	-/-	-/-	-	-
Bldg. 4079	19											
Bldg. 4027	20											
Bldg. 4014	21											
Bldg. 4272	22											
Bldg. 4575 Child Dev. Center	23				-/-		-/-	-/-	-/-	-/-	-	-
Hangar 10 East Side Sink	36											
Watering Truck 47	37						-/-					
Watering Truck 94	38							-/-				
#1 Cooling Tower-O Club	61											
Alt. Water Point	40											
Bldg. 1558 Power Prod.	41											
Base Housing Bldg. 4792	42											
Inside	42A											
Outside	42B											

(-) Negative Coliform
(+) Positive Coliform
(*) Positive Coliform & Chlorine

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 5/9/93 - 6/17/93

Location	I.D.	5-09-93	5-10-93	5-11-93	5-12-93	5-13-93	5-19-93	5-26-93	6-02-93	6-09-93	6-16-93	6-17-93
Base Housing Bldg. 4793	43											
Base Housing Bldg. 40854	44											
Inside	44A											
Outside	44B											
Bldg. 4087	45											
Bldg. 4613	46											
Bldg. 4744	47											
Bldg. 4763	48											
Bldg. 1836 Reservoir	49											
Outlet	49A				-/-				-/-	-/-	-	-
Inlet	49B				-/-		*/*		-/-	-/-	-	-
Bldg. 4022	50											
Bldg. 2021	51											
Bldg. 3786	52											
315 Topeka	53											
Bldg. 4671	54											
Bldg. 4006	55											
Pres. Maint. East Side	56											
Pres. Maint. West Side	57											
Bldg. 1306 Vanderberg	58											
Water Kit #1	59											
Water Kit #2	60											
Navy Chow Hall	61				-	-						
WSSC Vualt West Pipe	62											
Bldg. 4614 West Tower	63											
East Tower	64											
Sampler		BMK	BMK	BMK	BMK	BMK	CBK/FW	CBK/FW	FW	FW	CBK	CBK
Events		0	0	0	20	0	22	20	24	24	10	13
Positive Coliform		0	0	0	0	0	4	4	4	1	0	1
Percent Positive Coliform		-	-	-	0	-	18	20	17	4	0	8
Positive Chlorine		0	0	0	0	0	2	3	2	0	0	0
Month		5	5	5	5	5	5	5	6	6	6	6

(-) Negative Coliform
(+) Positive Coliform
[illegible]sitive [illegible]rm & [illegible]ne

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 6/22/93 - 8/5/93

Location	I.D.	6-22-93	6-24-93	6-30-93	7-07-93	7-14-93	7-15-93	7-20-93	7-23-93	7-29-93	8-04-93	8-05-93
Bldg. 1889 NCO Club	1											
Hangar 2, Bldg. 1794	2		*/*	-/*	-/-	-/-	-/+	-/*	-/-	-/-	-/-	
Hangar 2, Water Truck 80	2A											
Hangar 2, Water Truck 97	2B											
1535 BEE	3		-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-		
Bldg. 1050 MGMC	4		-/-	-/-	-/-	-/-	*/+	-/-	-/-	-/-	-/-	
4636 Poplar Ct.	5											
Bldg. 2086-A Havord Ave.	6		-/-									
5136-A Jerstad Ct.	7		-/-	-/-	-/*	-/-	*/+	-/*	-/-	-/-	-/-	
Bldg. 2137	8											
Hangar 8, Bldg. 1225	9		-/-	-/*	-/-	-/-	*/+	-/*	-/-	-/-	-/-	
Hangar 8, Watering Truck	9A		-/-									
AF 1	10								-			
4003	11											
113th Headquarters	12		-/+	-/-	-/-	-/-	-/-	-/+	*/-	-/-	-/-	
Bldg. 3575 BEE Lab	13											
3780-5 Louisiana Ave. Hsg.	14		-/-	-/*	-/-		*/+	*/*	-/-	-/-	-/*	
3780-3 Louisiana Ave. Hsg.	14A					-						
3780-6 Louisiana Ave. Hsg.	14B					-						
Bldg. 3763 Dining Hall	15		-/-	-/*	-/-	-/-	-/-	-/*	-/-	-/-	-/-	
Bldg. 4782	16											
Bldg. 4753	17											
Bldg. 4700 Youth Center	18		-/-	-/-	-/-	-/-	*/+	-/-	-/-	-/-	-/-	
Bldg. 4079	19											
Bldg. 4027	20											
Bldg. 4014	21											
Bldg. 4272	22											
Bldg. 4575 Child Dev. Center	23		-/-	-/-	-/-	-/-	+/-	+/+	-/+	-/-	-/-	
Hanger 10 East Side Sink	36											
Watering Truck 47	37											
Watering Truck 94	38											
#1 Cooling Tower-O Club	61											
Alt. Water Point	40											
Bldg 1558 Power Prod.	41											
Base Housing Bldg. 4792	42											
Inside	42A											
Outside	42B											

(-) Negative Coliform
(+) Positive Coliform
(*) Positive Coliform & Chlorine

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 6/22/93 - 8/5/93

Location	I.D.	6-22-93	6-24-93	6-30-93	7-07-93	7-14-93	7-15-93	7-20-93	7-23-93	7-29-93	8-04-93	8-05-93
Base Housing Bldg. 4793	43											
Base Housing Bldg. 40854	44											
Inside	44A											
Outside	44B											
Bldg. 4087	45											
Bldg. 4613	46											
Bldg. 4744	47											
Bldg. 4763	48											
Bldg. 1836 Reservoir	49											
Outlet	49A											
Inlet	49B											
Bldg 4022	50											
Bldg. 2021	51											
Bldg. 3786	52											
315 Topeka	53											
Bldg. 4671	54											
Bldg. 4006	55											
Pres. Maint. East Side	56											
Pres. Maint. West Side	57											
Bldg. 1306 Vanderberg	58											
Water Kit #1	59											
Water Kit #2	60											
Navy Chow Hall	61											
WSSC Vualt West Pipe	62	-/-										
Bldg. 4614 West Tower	63					-/-			*			
East Tower	64									-/-		*/*
Sampler		DMD	FW	FW	FW	FW	CBK	FW	FW	FW	CBK	CBK
Events		2	26	20	20	22	20	20	20	22	18	2
Positive Coliform		0	3	5	1	0	12	9	3	0	1	2
Percent Positive Coliform		0	12	25	5	0	60	45	15	0	6	100
Positive Chlorine		0	2	4	1	0	5	6	2	0	1	2
Month		6	6	6	7	7	7	7	7	7	8	8

(-) Negative Coliform
(+) Positive Coliform
(*) Positive Coliform & Chlorine

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 8/11/93 - 8/25/93

Location	I.D.	8-11-93	8-13-93	8-15-93	8-18-93	8-25-93
Bldg. 1889 NCO Club	1					
Hangar 2, Bldg. 1794	2	-/-			-/-	-/-
Hangar 2, Water Truck 80	2A					
Hangar 2, Water Truck 97	2B				-/-	
1535 BEE	3				-/-	*/*
Bldg. 1050 MGMC	4	-/-			-/-	-/-
4636 Poplar Ct.	5					
Bldg. 2086-A Havord Ave.	6					
5136-A Jerstad Ct.	7	-/-			-/-	-/-
Bldg. 2137	8					
Hangar 8, Bldg. 1225	9	-/-			*/-	-/-
Hangar 8, Watering Truck	9A					
AF 1	10				-/-	
4003	11					
113th Headquarters	12	-/-			-/-	+/+
Bldg 3575 BEE Lab	13					
3780-5 Louisiana Ave. Hsg.	14	-/-			-/-	*/*
3780-3 Louisiana Ave. Hsg.	14A					
3780-6 Louisiana Ave. Hsg.	14B					
Bldg. 3763 Dining Hall	15	-/-			-/-	-/-
Bldg. 4782	16					
Bldg. 4753	17					
Bldg. 4700 Youth Center	18				-/-	-/-
Bldg. 4079	19					
Bldg. 4027	20					
Bldg. 4014	21					
Bldg. 4272	22					
Bldg. 4575 Child Dev. Center	23	-/-			-/-	-/-
Hangar 10 East Side Sink	36					
Watering Truck 47	37					
Watering Truck 94	38					
#1 Cooling Tower-O Club	61					
Alt. Water Point	40					
Bldg. 1558 Power Prod.	41					
Base Housing Bldg. 4792	42					
Inside	42A					
Outside	42B					

(-) Negative Coliform
(+) Positive Coliform
(*) Positive Coliform & Chlorine

ANDREWS AIR FORCE BASE
Total Coliform Test Results: 8/11/93 - 8/25/93

Location	I.D.	8-11-93	8-13-93	8-15-93	8-18-93	8-25-93
Base Housing Bldg. 4793	43					
Base Housing Bldg. 40854	44					
Inside	44A					
Outside	44B					
Bldg. 4087	45					
Bldg. 4613	46					
Bldg. 4744	47					
Bldg. 4763	48					
Bldg. 1836 Reservoir	49					
Outlet	49A					
Inlet	49B					
Bldg. 4022	50					
Bldg. 2021	51					
Bldg. 3786	52					
315 Topeka	53					
Bldg. 4671	54					
Bldg. 4006	55					
Pres. Maint. East Side	56					
Pres. Maint. West Side	57					
Bldg. 1306 Vanderberg	58					
Water Kit #1	59					
Water Kit #2	60					
Navy Chow Hall	61					
WSSC Vualt West Pipe	62					
Bldg. 4614 West Tower	63					
East Tower	64					
Sampler		CBK	CBK	CBK	CBK	CBK
Events		16	0	0	24	20
Positive Coliform		0	0	0	1	6
Percent Positive Coliform		0	-	-	4	30
Positive Chlorine		0	0	0	1	4
Month		8	8	8	8	8

(-) Negative Coliform
(+) Positive Coliform
([illegible]) Positive Coliform & Chlorine

APPENDIX C

- AWWA Standard C651

  This Standard contains the disinfection procedures with which Andrews AFB must comply for the installation of new water distribution piping. These procedures are relevant in the event of a water main break.

- AWWA Standard C600-87, Section 4.0

  This standard contains the hydrostatic leakage and pressure test procedures with which Andrews AFB must comply for the installation of new water distribution piping.

- AWWA Standard C500-86, Section A.6

  This Standard contains the value management program with which Andrews AFB must comply for the inspection and maintenance of water distribution system gate valves.

American Water Works Association

ANSI / AWWA C651-86

(Revision of AWWA C601-81)

AWWA STANDARD
FOR
DISINFECTING WATER MAINS

AMERICAN NATIONAL STANDARD

First edition approved by AWWA Board of Directors Sept. 30, 1947.
This edition approved Jan. 26, 1986.

Approved by American National Standards Institute, Inc., Dec. 2, 1986

AMERICAN WATER WORKS ASSOCIATION

6666 West Quincy Avenue, Denver, Colorado 80235

American Water Works Association
6666 W. Quincy Ave., Denver, CO 80235 303/794-7711

AWWA C651a-90

Addendum to ANSI/AWWA C651-86 Standard for Disinfecting Water Mains

(The following addendum was approved by the AWWA Board of Directors on Jan. 29, 1990.)

P. 4 and 5, Sec. 5.1.2, last sentence p. 4 and continued on p. 5: delete "Permatex No. 1."* and revise the sentence to read as follows:

"The tablets shall be attached by a food-grade adhesive."*

P. 5, bottom of the page: delete the footnote in its entirety and insert the following:

*Examples of food-grade adhesives are Permatex Form-A-Gasket No. 2 and Permatex Clear RTV Silicone Adhesive Sealant, which are manufactured by Loctite Corporation, Kansas City, KS 66115. These products have both been approved by USDA for uses that may contact edible products. Neither product has been approved in accordance with NSF Standard 61. Other company products, such as Permatex Form-A-Gasket No. 1, have not received FDA approval.

Committee Personnel

The AWWA Standards Committee on Disinfection of Facilities, which reviewed and approved this standard, had the following personnel at the time of approval:

G.W. Adrian, *Chairman*

Consumer Members

G.W. Adrian, California Water Service Company, San Jose, Calif.	(AWWA)
R.P. Grady, Portland Water District, Portland, Maine	(NEWWA)
W.E. Neuman, American Water Works Service Company, Haddon Heights, N.J.	(AWWA)
J.P. Reames, Dallas City Water Utilities, Dallas, Texas	(AWWA)
C.H. Smith, Kankakee Water Company, Kankakee, Ill.	(AWWA)
J.A. Worthley,* American Water Works Service Company, Inc., Westwood, Mass.	(NEWWA)

General Interest Members

Ken Choquette,* Iowa Department of Health, Des Moines, Iowa	(CSSE)
J.V. Feuss, Cortland Health Department, Cortland, N.Y.	(AWWA)
C.B. Hagar, Black & Veatch, Kansas City, Mo.	(AWWA)
Ira Markwood, US Environmental Protection Agency, Springfield, Ill.	(CSSE)
T.W. Walker, New York Department of Health, Victor, N.Y.	(AWWA)
Michael Wentink, Nebraska Department of Health, Scottsbluff, Neb.	(AWWA)
C.L. Young, California Department of Health, San Francisco, Calif.	(AWWA)

Producer Members

Wayne Huebner, Wallace & Tiernan Division, Belleville, N.J.	(AWWA)

*Alternate

Contents

Foreword

This foreword is for information only and is not a part of AWWA C651.

I. History of Standard. This standard was first approved on Sept. 30, 1947, by the AWWA Board of Directors and published as 7D.2-1948, A Procedure for Disinfecting Water Mains. Revisions were approved by the AWWA Board of Directors on Sept. 14, 1948; Mar. 6, 1953; May 27, 1954; June 2, 1968; and June 7, 1981, all under the designation AWWA C601, Standard for Disinfecting Water Mains. The designation of the standard has been changed to AWWA C651 with this revision.

II. Discussion. This standard describes methods of disinfecting newly constructed potable-water mains; mains that have been removed from service for planned repairs or for maintenance that exposes them to contamination; mains that have undergone emergency repairs due to physical failure; and mains that, under normal operation, continue to show the presence of coliform organisms.

It is generally easier to achieve disinfection of a new main than of one given emergency repairs. The unsanitary conditions created when an existing main bursts or is cut into are likely to be difficult to control, and the need to quickly restore water service to the community requires more rapid disinfection procedures than those prescribed for newly constructed mains.

Crews responsible for the repair of mains should be aware of the potential health hazards and should be trained to carefully observe prescribed construction practices and disinfection procedures.

Disinfection requires skills not necessarily mastered by competent construction crews, and some utilities prefer to disinfect water mains using specially trained treatment crews. However, because the effectiveness of disinfection depends, in large measure, on maintaining clean pipes and avoiding major contamination during construction, there are some advantages in having the construction crew retain the responsibility for disinfection. Furthermore, certain functions, such as the placing of tablets, must be performed by the construction crew. In either case, it is strongly recommended that pipe crews be trained to be aware of the need for maintaining clean pipes and avoiding contamination.

Three methods of disinfecting newly constructed water mains are described in this standard: the tablet method, the continuous-feed method, and the slug method. The utility should decide which of these methods is most suitable for a given situation. Choice of the method used should include consideration of the length and diameter of the main, type of joints present, availability of materials, equipment required for disinfection, training of the personnel who will perform the disinfection, and safety considerations.

For example, the continuous-feed or slug methods should be used with gas chlorination only where properly designed and constructed equipment is available; makeshift equipment is not acceptable where liquid-chlorine cylinders are used. Thorough consideration should be given to the impact of highly chlorinated water flushed to the receiving environment. If there is any question that damage may be caused by a chlorinated-waste discharge (to fish life, plant life, physical installations, or other downstream water uses of any type), then an adequate amount of reducing agent should be applied to water being disposed of in order to thoroughly neutralize the chlorine residual remaining in the water.

The tablet method cannot be used unless the main can be kept clean and dry. It cannot be used in large-diameter mains if it is necessary for a worker to enter the main to grout joints or perform inspection, because the tablets may release toxic fumes after exposure to moist air. When using the tablet method, the chlorine concentration is not uniform throughout the main because the hypochlorite solution is dense and tends to concentrate at the bottom of the pipe. The use of the tablet method precludes preliminary flushing. The tablet method is

convenient to use in mains having diameters up to 24 in., and it requires no special equipment.

The continuous-feed method is suitable for general application. Preliminary flushing removes light particulates from the main but not from the pipe-joint spaces. The chlorine concentration is uniform throughout the main.

The slug method is suitable for use in large-diameter mains where the volume of water involved makes the continuous-feed method impractical. The slug method results in appreciable savings in chemicals in long, large-diameter mains, and reduces the volume of heavily chlorinated water to be flushed to waste.

III. Major Revisions. Redesignation as AWWA C651 and dimensional changes to Figure 1, Suggested Combination Blowoff and Sampling Tap, are the only changes made in this revision of the standard.

IV. Information Regarding Use of This Standard. This standard is written as though the work will be done by the owner's personnel. Where the owner is contracting for such work to be done under a separate contract or as part of a contract for installing mains* appropriate provisions should be included in the contract agreement to assure that the contractor is specifically instructed as to his responsibilities. As a minimum, the owner should specify:

1. Standard used — that is, AWWA C651, Standard for Disinfecting Water Mains.
2. Form of chlorine to be used (Sec. 2.1, Sec. 2.2, and Sec. 2.3).
3. Method of chlorination (Sec. 5.1, Sec. 5.2, and Sec. 5.3).
4. Places where flushing may be done, rates of flushing, and locations of drainage facilities (Sec. 5.2.2, Sec. 6.1, and Sec. 6.2).
5. The number and frequency of samples for bacteriological tests (Sec. 7.1, Sec. 7.2, and Sec. 8).
6. Method of taking samples (Sec. 7.3).

*See other AWWA standards and manuals for design criteria and installation procedures for various pipe materials.

American Water Works Association

AWWA C651-86
(Revision of AWWA C601-81)

AWWA STANDARD FOR
DISINFECTING WATER MAINS

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard presents essential procedures for disinfecting new and repaired water mains. All new water mains shall be disinfected before they are placed in service. All water mains taken out of service for inspecting, repairing, or other activity that might lead to contamination of water shall be disinfected before they are returned to service.

Sec. 1.2 References

This standard references the following documents. The latest current edition of each forms a part of this standard where and to the extent specified herein. In case of any conflict, the requirements of this standard shall prevail.

AWWA B300—Standard for Hypochlorites.

AWWA B301—Standard for Liquid Chlorine.

Simplified Procedures for Water Examination. AWWA Manual M12. AWWA, Denver, Colo. (1978).

Standard Methods for the Examination of Water and Wastewater. APHA,* AWWA, and WPCF.† Washington, D.C. (16th ed., 1984).

Additional materials relating to activity under this standard include:

Material Safety Data Sheets for forms of chlorine used (provided by suppliers).

Chlorine Institute, Inc.‡—*Chlorine Manual.*

AWWA—*Water Quality and Treatment.*

AWWA—*Introduction to Water Treatment.*

Safety Practice for Water Utilities. AWWA Manual M3. AWWA, Denver, Colo. (1983).

Water Chlorination Principles and Practices. AWWA Manual M20. AWWA, Denver, Colo. (1973).

*American Public Health Association, 1015 15th St. N.W., Washington, DC 20005.
†Water Pollution Control Federation, 2626 Pennsylvania Ave. N.W., Washington, DC 20037.
‡Chlorine Institute, Inc., 70 W. 40th St., New York, NY 10018.

Sec. 1.3 Record of Compliance

The record of compliance shall be the bacteriological test results certifying the water sampled from the water main to be free of coliform bacteria contamination.

SECTION 2: FORMS OF CHLORINE FOR DISINFECTION

The forms of chlorine that may be used in the disinfection operations are liquid chlorine, sodium hypochlorite solution, and calcium hypochlorite granules or tablets.

Sec. 2.1 Liquid Chlorine*

Liquid chlorine contains 100-percent available chlorine and is packaged in steel containers usually of 100-lb, 150-lb, or 1-ton net chlorine weight. Liquid chlorine shall be used only (1) in combination with appropriate gas-flow chlorinators and ejectors to provide a controlled high-concentration solution feed to the water to be chlorinated; (2) under the direct supervision of a person who is familiar with the physiological, chemical, and physical properties of liquid chlorine, and who is trained and equipped to handle any emergency that may arise; and (3) when appropriate safety practices are observed to protect working personnel and the public.

Sec. 2.2 Sodium Hypochlorite†

Sodium hypochlorite is available in liquid form in glass, rubber-lined, or plastic containers typically ranging in size from 1 qt to 5 gal; containers of 30 gal or larger sizes may be available in some areas. Sodium hypochlorite contains approximately 5-percent to 15-percent available chlorine, but care must be used in control of conditions and length of storage to minimize its deterioration. (Available chlorine is expressed as a percent of weight when the concentration is 5 percent or less, and usually as a percent of volume for higher concentrations. Percent × 10 = grams of available chlorine per litre of hypochlorite.)

Sec. 2.3 Calcium Hypochlorite†

Calcium hypochlorite is available in granular form or in approximately 5-g tablets, and contains approximately 65-percent available chlorine by weight. The material should be stored in a cool, dry, and dark environment to minimize its deterioration.

SECTION 3: BASIC DISINFECTION PROCEDURE

The basic disinfection procedure consists of:

1. Preventing contaminating materials from entering the water main during storage, construction, or repair.
2. Removing, by flushing or other means, those materials that may have entered the water main.
3. Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.
4. Determining the bacteriological quality by laboratory test after disinfection.

*See AWWA B301—Standard for Liquid Chlorine.
†See AWWA B300—Standard for Hypochlorites.

SECTION 4: PREVENTIVE AND CORRECTIVE MEASURES DURING CONSTRUCTION

Heavy particulates generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing such organisms. It is, therefore, essential that the procedures of this section be observed to assure that a water main and its appurtenances are thoroughly clean for the final disinfection by chlorination.

Sec. 4.1 Keeping Pipe Clean and Dry

Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Rodent-proof plugs may be used where it is determined that watertight plugs are not practicable and where thorough cleaning will be performed by flushing or other means.

Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipe laying, the less likelihood of contamination.

Sec. 4.2 Joints

Joints of all pipe in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

Sec. 4.3 Packing Materials

Yarning or packing material shall consist of molded or tubular rubber rings, or rope of treated paper or other approved materials. Materials such as jute or hemp shall not be used. Packing material shall be handled in a manner that avoids contamination. If asbestos rope is used, it shall be handled in a manner that prevents asbestos from being introduced into the water-carrying portion of the pipe.

Sec. 4.4 Sealing Materials

No contaminated material or any material capable of supporting prolific growth of microorganisms shall be used for sealing joints. Sealing material or gaskets shall be handled in a manner that avoids contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. It shall be delivered to the job in closed containers and shall be kept clean.

Sec. 4.5 Cleaning and Swabbing

If dirt enters the pipe, and in the opinion of the owner's engineer or job superintendent the dirt will not be removed by the flushing operation, the interior of the pipe shall be cleaned by mechanical means and then shall be swabbed with a 1-percent hypochlorite disinfecting solution. Cleaning with the use of a pig, swab, or "go-devil" should be undertaken only when the owner's engineer or job superintendent has determined that such operation will not force mud or debris into pipe-joint spaces.

Sec. 4.6 Wet-Trench Construction

If it is not possible to keep the pipe and fittings dry during installation, every effort shall be made to assure that any of the water that may enter the pipe-joint spaces contains an available-chlorine concentration of approximately 25 mg/L. This may be accomplished by adding calcium hypochlorite granules or tablets to each length of pipe before it is lowered into a wet trench, or by treating the trench water with hypochlorite tablets.

Sec. 4.7 Flooding by Storm or Accident During Construction

If the main is flooded during construction, it shall be cleared of the flood water by draining and flushing with potable water until the main is clean. The section exposed to the flood water shall then be filled with a chlorinated potable water that, at the end of a 24-h holding period, will have a free chlorine residual of not less than 25 mg/L. The chlorinated water may then be drained or flushed from the main. After construction is completed, the main shall be disinfected using the continuous-feed or slug method.

SECTION 5: METHODS OF CHLORINATION

Three methods of chlorination are explained in this section: tablet, continuous feed, and slug. Information in the foreword will be helpful in determining the method to be used. The tablet method gives an average chlorine dose of approximately 25 mg/L; the continuous-feed method gives a 24-h chlorine residual of not less than 10 mg/L; and the slug method gives a 3-h exposure of not less than 50 mg/L free chlorine.

Sec. 5.1 Tablet Method

The tablet method consists of placing calcium hypochlorite granules and tablets in the water main as it is being installed and filling the main with potable water when installation is completed.

This method may be used only if the pipes and appurtenances are kept clean and dry during construction.

5.1.1 *Placing of calcium hypochlorite granules.* During construction, calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-ft intervals. The quantity of granules shall be as shown in Table 1.

WARNING: This procedure must not be used on solvent-welded plastic or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

Table 1 Ounces of Calcium Hypochlorite Granules to be Placed at Beginning of Main and at Each 500-ft Interval

Pipe Diameter *in.*	Calcium Hypochlorite Granules *oz*
4	0.5
6	1.0
8	2.0
12	4.0
16 and larger	8.0

5.1.2 *Placing of calcium hypochlorite tablets.* During construction, 5-g calcium hypochlorite tablets shall be placed in each section of pipe and also one such tablet shall be placed in each hydrant, hydrant branch, and other appurtenance. The number of 5-g tablets required for each pipe section shall be $0.0012\,d^2L$ rounded to the next higher integer, where d is the inside pipe diameter, in inches, and L is the length of the pipe section, in feet. Table 2 shows the number of tablets required for commonly used sizes of pipe. The tablets shall be

Table 2 Number of 5-g Calcium Hypochlorite Tablets Required for Dose of 25 mg/L*

Pipe Diameter *in.*	Length of Pipe Section *ft* 13 or less	18	20	30	40
	Number of 5-g Calcium Hypochlorite Tablets				
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13

*Based on 3.25 g available chlorine per tablet; any portion of tablet rounded to next higher number.

attached by an adhesive such as Permatex No. 1* or equal. There shall be no adhesive on the tablet except on the broad side attached to the surface of the pipe. Attach all the tablets inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section so it can be readily determined that the pipe is installed with the tablets at the top.

5.1.3 *Filling and contact.* When installation has been completed, the main shall be filled with water at a rate such that water within the main will flow at a velocity no greater than 1 ft/s. Precautions shall be taken to assure that air pockets are eliminated. This water shall remain in the pipe for at least 24 h. If the water temperature is less than 41°F (5°C), the water shall remain in the pipe for at least 48 h. Valves shall be positioned so that the strong chlorine solution in the treated main will not flow into water mains in active service.

Sec. 5.2 Continuous-Feed Method

The continuous-feed method consists of placing calcium hypochlorite granules in the main during construction (optional), completely filling the main to remove all air pockets, flushing the completed main to remove particulates, and filling the main with potable water chlorinated so that after a 24-h holding period in the main there will be a free chlorine residual of not less than 10 mg/L.

5.2.1 *Placing calcium hypochlorite granules.* At the option of the engineer, calcium hypochlorite granules shall be placed in pipe sections as specified in Sec. 5.1.1. The purpose of this procedure is to provide a strong chlorine concentration in the first flow of flushing water that flows down the main. This procedure is recommended particularly where the type of pipe is such that this first flow of water will flow into annular spaces at pipe joints.

5.2.2 *Preliminary flushing.* Before being chlorinated, the main shall be filled to eliminate air pockets and shall be flushed to remove particulates. The flushing velocity in the main shall not be less than 2.5 ft/s unless the owner's engineer or job superintendent determines that conditions do not permit the required flow to be discharged to waste. Table 3 shows the rates of flow required to produce a velocity of 2.5 ft/s in pipes of various sizes. Note that flushing is no substitute for preventive measures during construction. Certain contaminants, such as caked deposits, resist flushing at any feasible velocity.

In mains of 24-in. or larger diameter, an acceptable alternative to flushing is to broom-sweep the main, carefully removing all sweepings prior to chlorinating the main.

*A product of the Permatex Co., Brooklyn, N.Y., and Kansas City, Kan.

Table 3 Required Flow and Openings to Flush Pipelines (40 psi Residual Pressure in Water Main)*

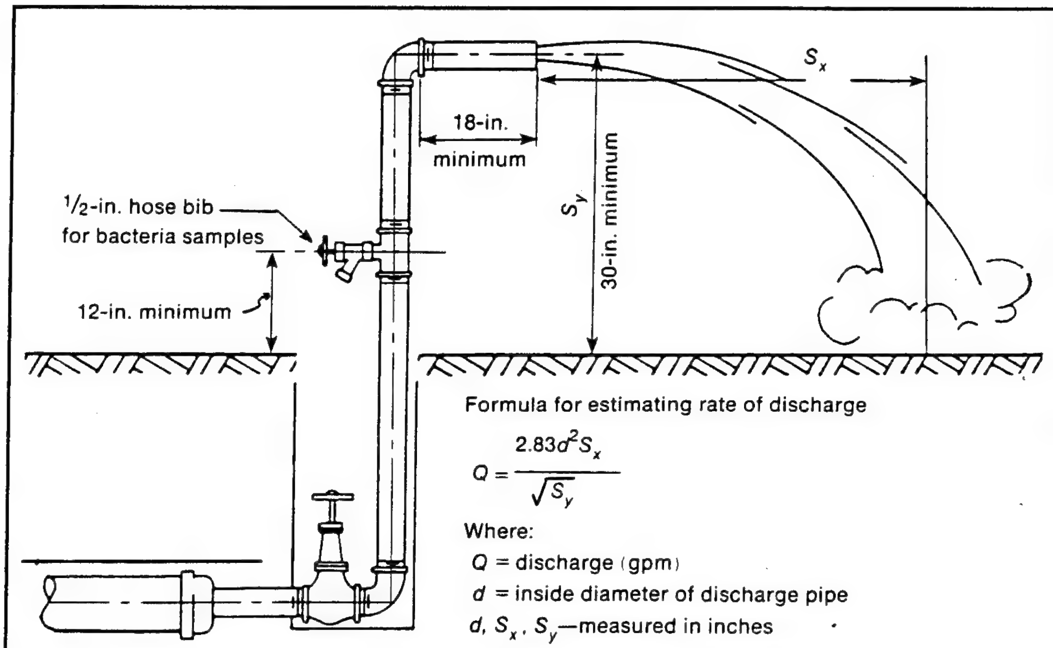
Pipe Diameter *in.*	Flow Required to Produce 2.5 ft/s (approx.) Velocity in Main *gpm*	Size of Tap *in.* 1	1½	2	Number of 2½-in. Hydrant Outlets*
		Number of Taps on Pipe†			
4	100	1	—	—	1
6	200	—	1	—	1
8	400	—	2	1	1
10	600	—	3	2	1
12	900	—	—	2	2
16	1600	—	—	4	2

*With a 40-psi pressure in the main with the hydrant flowing to atmosphere, a 2½-in. hydrant outlet will discharge approximately 1000 gpm and a 4½-in. hydrant outlet will discharge approximately 2500 gpm.
†Number of taps on pipe based on discharge through 5 ft of galvanized iron (GI) pipe with one 90° elbow.

5.2.3 *Chlorinating the main.*

1. Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate into the newly laid water main. In the absence of a meter, the rate may be approximated by methods such as placing a Pitot gauge in the discharge, measuring the time to fill a container of known volume, or measuring the trajectory of the discharge and using the formula shown in Figure 1.

2. At a point not more than 10 ft downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine. To assure that this concentration is provided, measure the chlorine concentration at regular intervals in accordance with the procedures described in the current edition of *Standard Methods for the Examination of Water or Wastewater* or AWWA Manual M12, or using appropriate chlorine test kits. (See Appendix A.)



Formula for estimating rate of discharge

$$Q = \frac{2.83 d^2 S_x}{\sqrt{S_y}}$$

Where:
Q = discharge (gpm)
d = inside diameter of discharge pipe
d, S_x, S_y—measured in inches

Figure 1 Suggested Combination Blowoff and Sampling Tap

Table 4 Chlorine Required to Produce 25-mg/L Concentration in 100 ft of Pipe—by Diameter

Pipe Diameter *in*	100-percent Chlorine *lb*	1-percent Chlorine Solution *gal*
4	.013	.16
6	.030	.36
8	.054	.65
10	.085	1.02
12	.120	1.44
16	.217	2.60

Table 4 gives the amount of chlorine required for each 100 ft of pipe of various diameters. Solutions of 1-percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires 1 lb of calcium hypochlorite in 8 gal of water.

3. During the application of chlorine, valves shall be positioned so that the strong chlorine solution in the main being treated will not flow into water mains in active service. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24 h, during which time all valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances. At the end of this 24-h period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine.

4. Direct-feed chlorinators, which operate solely from gas pressure in the chlorine cylinder, shall not be used for application of liquid chlorine. (The danger of using direct-feed chlorinators is that water pressure in the main can exceed gas pressure in the chlorine cylinder. This allows a backflow of water into the cylinder, resulting in severe cylinder corrosion and escape of chlorine gas.) The preferred equipment for applying liquid chlorine is a solution-feed, vacuum-operated chlorinator and a booster pump. The vacuum-operated chlorinator mixes the chlorine gas in solution water; the booster pump injects the chlorine-gas solution into the main to be disinfected. Hypochlorite solutions may be applied to the water main with a gasoline or electrically powered chemical-feed pump designed for feeding chlorine solutions. Feed lines shall be of such material and strength as to safely withstand the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the solution is applied to the main.

Sec. 5.3 Slug Method

The slug method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to eliminate all air pockets, flushing the main to remove particulates, and slowly flowing through the main a slug of water dosed with chlorine to a concentration of 100 mg/L. The slow flow ensures that all parts of the main and its appurtenances will be exposed to the highly chlorinated water for a period of not less than 3 h.

5.3.1 *Placing calcium hypochlorite granules.* Same as Sec. 5.2.1.

5.3.2 *Preliminary flushing.* Same as Sec. 5.2.2.

5.3.3 *Chlorinating the main.*

1. Same as Sec. 5.2.3(1).

2. At a point not more than 10 ft downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 mg/L free chlorine. To ensure that this concentration is

provided, the chlorine concentration should be measured at regular intervals. The chlorine shall be applied continuously and for a sufficient period to develop a solid column, or "slug," of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/L for at least 3 h.

3. The free chlorine residual shall be measured in the slug as it moves through the main. If at any time it drops below 50 mg/L, the flow shall be stopped, chlorination equipment shall be relocated at the head of the slug, and, as flow is resumed, chlorine shall be applied to restore the free chlorine in the slug to not less than 100 mg/L.

4. As the chlorinated water flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

SECTION 6: FINAL FLUSHING

Sec. 6.1 Clearing the Main of Heavily Chlorinated Water

After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system or is acceptable for domestic use.

Sec. 6.2 Disposing of Heavily Chlorinated Water

The environment to which the chlorinated water is to be discharged shall be inspected. If there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. (See Appendix B for neutralizing chemicals.) Where necessary, federal, state, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

SECTION 7: BACTERIOLOGICAL TESTS

Sec. 7.1 Standard Conditions

After final flushing and before the water main is placed in service, a sample or samples shall be collected from the end of the line, shall be tested for bacteriological quality in accordance with *Standard Methods for the Examination of Water and Wastewater*, and shall show the absence of coliform organisms. A standard plate count may be required at the option of the engineer. At least one sample shall be collected from the new main and one from each branch. In case of extremely long mains, it is desirable that samples be collected along the length of the line as well as at its end.

Sec. 7.2 Special Conditions

If, during construction, trench water has entered the main, or if in the opinion of the owner's engineer or job superintendent, excessive quantities of dirt or debris have entered the main, bacteriological samples shall be taken at intervals of approximately 200 ft and shall be identified by location. Samples shall be taken of water that has stood in the main for at least 16 h after final flushing has been completed.

Sec. 7.3 Sampling Procedure

Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate as required by *Standard Methods for the Examination of Water and*

Wastewater. No hose or fire hydrant shall be used in collection of samples. A suggested combination blowoff and sampling tap useful for mains up to and including 8-in. diameter is shown in Figure 1. A corporation cock may be installed in the main with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

SECTION 8: REDISINFECTION

If the initial disinfection fails to produce satisfactory bacteriological samples, the main may be reflushed and shall be resampled. If check samples show the presence of coliform organisms, then the main shall be rechlorinated by the continuous-feed or slug method of chlorination until satisfactory results are obtained.

NOTE: High velocities in the existing system, resulting from flushing the new main, may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is well to sample water entering the new main.

SECTION 9: DISINFECTION PROCEDURES WHEN CUTTING INTO OR REPAIRING EXISTING MAINS

The following procedures apply primarily when mains are wholly or partially dewatered. After the appropriate procedures have been completed, the main may be returned to service prior to completion of bacteriological testing in order to minimize the time customers are out of water. Leaks or breaks that are repaired with clamping devices while the mains remain full of pressurized water present little danger of contamination and require no disinfection.

Sec. 9.1 Trench Treatment

When an old main is opened, either by accident or by design, the excavation will likely be wet and may be badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.

Sec. 9.2 Swabbing with Hypochlorite Solution

The interiors of all pipe and fittings (particularly couplings and sleeves) used in making the repair shall be swabbed or sprayed with a 1-percent hypochlorite solution before they are installed.

Sec. 9.3 Flushing

Thorough flushing is the most practical means of removing contamination introduced during repairs. If valve and hydrant locations permit, flushing toward the work location from both directions is recommended. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water is eliminated.

Sec. 9.4 Slug Chlorination

Where practical, in addition to the procedures above, a section of main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated as described in Sec. 5.3, except that the dose may be increased to as much as

300 mg/L and the contact time reduced to as little as 15 min. After chlorination, flushing shall be resumed and continued until discolored water is eliminated and the water is free of noticeable chlorine odor.

Sec. 9.5 Sampling

Bacteriological samples shall be taken after repairs are completed to provide a record for determining the procedure's effectiveness. If the direction of flow is unknown, samples shall be taken on each side of the main break. If positive bacteriological samples are recorded, the situation shall be evaluated by a qualified engineer who can determine corrective action, and daily sampling shall be continued until two consecutive negative samples are recorded.

SECTION 10: SPECIAL PROCEDURE FOR CAULKED TAPPING SLEEVES

Before a tapping sleeve is installed, the exterior of the main to be tapped shall be thoroughly cleaned, and the interior surface of the sleeve shall be lightly dusted with calcium hypochlorite powder.

Tapping sleeves are used to avoid shutting down the main to be tapped. After the tap is made, it is impossible to disinfect the annulus without shutting down the main and removing the sleeve. The space between the tapping sleeve and the tapped pipe is normally ½ in., more or less, so that as little as 100 mg of calcium hypochlorite powder per square foot will provide a chlorine concentration of over 50 mg/L.

APPENDIX A

Chlorine Residual Testing

This appendix is for information only and is not a part of AWWA C651.

SECTION A.1: DPD DROP DILUTION METHOD (FOR FIELD TEST)

The DPD drop dilution method of approximating total residual chlorine is suitable for concentrations above 10 mg/L, such as are applied in the disinfection of water mains or tanks.

Apparatus:

1. A graduated cylinder for measuring distilled water.
2. An automatic or safety pipette.
3. Two dropping pipettes that deliver a 1-mL sample in 20 drops. One pipette is for dispensing the water sample and the other is for dispensing the DPD and buffer solutions. The pipettes should not be interchanged.
4. A comparator kit containing a suitable range of standards.

Reagents:

1. DPD indicator solution. Prepare as prescribed in *Standard Methods for the Examination of Water and Wastewater*, (16th ed.), Section 408E, p. 309.
2. Phosphate buffer solution. Prepare as prescribed in *Standard Methods for the Examination of Water and Wastewater*, (16th ed.), Section 408E, p. 309.

Procedure:

1. Add 10 drops of DPD solution and 10 drops of buffer solution (or 20 drops of combined DPD–buffer solution) to a comparator cell.
2. Fill the comparator cell to the 10-mL mark with distilled water.
3. With a dropping pipette, add the water sample one drop at a time, allowing mixing, until a red color is formed that matches one of the color standards.
4. Record the total number of drops used and the final chlorine reading obtained (that is, the chlorine reading of the matched standard).
5. Calculate the milligrams per litre of free residual chlorine as follows:

$$\text{mg/L Chlorine} = \frac{\text{reading} \times 200}{\text{drops of sample}}$$

SECTION A.2: HIGH-RANGE CHLORINE TEST KITS

Several manufacturers produce high-range chlorine test kits that are inexpensive, easy to use, and satisfactory for the precision required.

APPENDIX B

Disposal of Heavily Chlorinated Water

This appendix is for information only and is not a part of AWWA C651.

1. Check with local sewer department for conditions of disposal to sanitary sewer.
2. Chlorine residual of water being disposed will be neutralized by treating with one of the chemicals listed in Table B.1.

Table B.1 Pounds of Chemicals Required to Neutralize Various Residual Chlorine Concentrations in 100 000 gal of Water*

Residual Chlorine Concentration *mg/L*	Sulfur Dioxide (SO_2)	Sodium Bisulfate ($NaHSO_3$)	Sodium Sulfite (Na_2SO_3)	Sodium Thiosulfate ($Na_2S_2O_3 \cdot 5H_2O$)
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

*Except for residual chlorine concentration, all amounts are in pounds.

American Water Works Association
ANSI/AWWA C600-87
(Revision of ANSI/AWWA C600-82)

AWWA STANDARD

FOR

INSTALLATION OF DUCTILE-IRON WATER MAINS AND THEIR APPURTENANCES

AMERICAN NATIONAL STANDARD

First edition approved by AWWA Board of Directors May 8, 1977.
This edition approved June 14, 1987.

Approved by American National Standards Institute, Inc., Dec. 2, 1987.

AMERICAN WATER WORKS ASSOCIATION

6666 West Quincy Avenue, Denver, Colorado 80235

Contents

3.8.5 *Restrained joints.* Restraining mechanisms for push-on or mechanical joints may be used instead of concrete backing, if so indicated in the plans and specifications. Tie rods, clamps, or other components of dissimilar metal shall be protected against corrosion by hand application of a suitable coating or by encasement of the entire assembly with 8-mil (0.2-mm) loose polyethylene film in accordance with ANSI/AWWA C105/A21.5.

Sec. 3.9 Flushing

Foreign material left in the pipelines during installation often results in valve or hydrant seat leakage during pressure tests. Every effort shall be made to keep lines clean during installation. Thorough flushing is recommended prior to a pressure test; flushing should be accomplished by partially opening and closing valves and hydrants several times under expected line pressure, with flow velocities adequate to flush foreign material out of the valves and hydrants.

SECTION 4: HYDROSTATIC TESTING

WARNING: The testing methods described in this section are specific for water-pressure testing. These procedures should not be applied for air-pressure testing because of the serious safety hazards involved.

Sec. 4.1 Pressure and Leakage Test

4.1.1 *Test restrictions.*

Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section.

Test pressure shall not exceed pipe or thrust-restraint design pressures.

The hydrostatic test shall be of at least 2-h duration.

Test pressure shall not vary by more than ±5 psi (35 MPa or 0.35 bar) for the duration of the test.

Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests at these pressures, the test setup should include provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

Test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.

4.1.2 *Pressurization.* After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing. Each valved section of pipe shall be slowly filled with water, and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the owner. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. It is good practice to allow the system to stabilize at the test pressure before conducting the leakage test.

4.1.3 *Air removal.* Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the owner.

4.1.4 *Examination.* Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to the owner.

4.1.5 *Leakage defined.* Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi (35 MPa or 0.35 bar) of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

4.1.6 *Allowable leakage.* No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133{,}200} \qquad \text{(Eq 1)}$$

Where:

L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

In metric units,

$$L_m = \frac{SD\sqrt{P}}{2816} \qquad \text{(Eq 2)}$$

Where:

L_m = allowable leakage, in litres per hour.
S = length of pipe tested, in metres.
D = nominal diameter of the pipe, in inches.
P = average test pressure during the leakage test, in bars.

These formulas are based on an allowable leakage of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

4.1.6.1 Allowable leakage at various pressures is shown in Table 6.

Table 6 Allowable Leakage per 1000 ft (305 m) of Pipeline*—*gph*†

Avg. Test Pressure *psi (bar)*	Nominal Pipe Diameter—*in.* 3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450 (31)	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60
400 (28)	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11
350 (24)	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58
300 (21)	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02
275 (19)	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72
250 (17)	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41
225 (16)	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03
200 (14)	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73
175 (12)	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36
150 (10)	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97
125 (9)	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53
100 (7)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

†To obtain leakage in litres/hour, multiply the values in the table by 3.785.

4.1.6.2 When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gph/in. (0.0012 L/h/mm) of nominal valve size shall be allowed.

4.1.6.3 When hydrants are in the test section, the test shall be made against closed hydrant valves.

4.1.7 *Acceptance of installation.* Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified in Sec. 4.1.6, the contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance.

4.1.7.1 All visible leaks are to be repaired, regardless of the amount of leakage.

SECTION 5: DISINFECTION

A newly installed main shall be disinfected in accordance with ANSI/AWWA C651. Following chlorination, the main should be flushed as soon as possible (within 24 hours), since prolonged exposure to high concentrations of chlorine might damage the asphaltic seal coating.

American Water Works Association
ANSI / AWWA C500-86
(Revision of AWWA C500-80)

AWWA STANDARD

FOR

GATE VALVES FOR WATER AND SEWERAGE SYSTEMS

AMERICAN NATIONAL STANDARD

First edition approved by AWWA Board of Directors June 24, 1913.
This edition approved June 22, 1986.

Approved by American National Standards Institute, Inc., Jan. 28, 1987.

AMERICAN WATER WORKS ASSOCIATION

6666 West Quincy Avenue, Denver, Colorado 80235

Contents

SECTION A.6: INSPECTION AND MAINTENANCE PROGRAM

Each gate valve should be operated through a full cycle and returned to its normal position on a schedule designed to prevent a buildup of tuberculation or other deposits that would render the valve inoperable or prevent a tight shutoff. The interval of time between operations of large-diameter valves, valves in critical locations, or valves subjected to severe operating conditions should be shorter than for other less important installations, but can be for whatever period is shown to be satisfactory based on local experience. The number of turns required to complete the operation cycle should be recorded and then compared with permanent installation records to ensure full disc travel.

When using portable auxiliary power actuators with input torque capacities exceeding the maximum operating torques recommended in Sec. A.5.7.6, extreme care should be exercised to avoid application of excessive torque to the valve stem. If the actuator has a torque-limiting device, it should be set below the values in Sec. A.5.7.6. If there is no torque-limiting device, the recommended practice is to stop the power actuator three or four turns before the valve is fully opened or fully closed, and complete the operation manually. Maintenance should be performed at the time a malfunction is discovered to avoid a return trip to the same valve and to prevent forgetting about it altogether. A recording system should be adopted that will provide a written record of valve location, condition, and maintenance corrective action on installation, and each subsequent inspection of the gate valve.

SECTION A.7: INSPECTION AND MAINTENANCE PROCEDURES

Sec. A.7.1 Inspection

Each gate valve should be operated through one complete operating cycle. If the stem action is tight as a result of "hard-water" buildup on the stem threads, the operation should be repeated several times until the opening and closing action is smooth and free. With the discs in the partially open position, a visual inspection should be performed, where practical, to check for leakage at all joints, connections, and areas of packing or seals. If leakage is observed, all defective O-rings, seals, gaskets, or end-connection sealing members should be replaced. If the leakage cannot be corrected immediately, the nature of the leakage should be reported promptly to those responsible for repairs. If the valve is inoperable or irreparable, its location should be clearly marked to prevent loss of time for repair crews. The condition of the gate valve and, if possible, the disc position, should be reported to the proper parties responsible for repairs. In addition, all fire departments and other appropriate municipal departments should be informed that the valve is out of service.

Sec. A.7.2 Record Keeping

In order to carry out a meaningful inspection and maintenance program, it is essential that the location, make, type, size, and date of installation of each valve be recorded. Depending on the type of record keeping used, other information may be entered in the permanent record. When a gate valve is inspected, an entry should be made in the permanent record indicating date of inspection and condition of the gate valve. If repair work is necessary, it should be indicated, and on completion, the nature of the repairs and date completed should be correctly recorded.

APPENDIX D

BACTERIOLOGICAL EXAMINATION OF DRINKING WATER PROCEDURES

This appendix contains the procedures for the collection, analysis, and quality control procedures with which Andrews AFB must comply for the bacteriological examination of drinking water.

BACTERIOLOGICAL EXAMINATION OF DRINKING WATER PROCEDURES

1. Purpose: This attachment establishes procedures for the collection, analysis, and Quality Control (QC) procedures for the bacteriological examination of drinking water.

2. Collection:

a. Samples will be collected no later than Wednesday of each week IAW Attachment 6.

b. Samples will be collected in whirl-pac bags impregnated with sodium thiosulphate.

(1) Select at least one sample bag at random from each batch of sterile bags and confirm sterility by adding approximately a 25 ml volume of a sterile non-selective broth (e.g., tryptic soy, trypticase soy, or tryptone broth). Incubate at 35 degrees ± 0.5 degrees Celsius for 24 hours and check for growth.

(2) If sterility check passes, record the results in the water lab QC log book and on the box of bags.

(3) If sterility check fails, re-check two additional bags at random. If either bag fails, reject the lot and notify the manufacturer. Record the results in the water lab QC log book.

c. Open water tap fully and allow water to run for three minutes or for a time sufficient to permit clearing the service line.

d. Obtain pH and Free Available Chlorine (FAC) measurement and note pH, FAC, time and date on bag.

(1) Obtain FAC using the DPD Colorimetric Method.

(a) Rinse the test tube with the sample water then fill to the top line.

(b) Add one DPD #1 tablet, cap and shake the test tube until the tablet has dissolved.

(c) Immediately insert the test tube into the comparator and match the color of the sample with the color standards.

(2) Obtain pH using the HACH ONE pH Meter.

(a) Date buffers when received and discard prior to the expiration date.

(b) Standardize pH meter each use period with pH 7.0 and pH 4.0 standard buffers. Document results in water lab QC log book.

(c) Fill container with enough water to obtain pH value on site. Swirl probe slowly in water until pH meter stabilizes.

(d) Upon returning to shop, check calibration of meter by obtaining results in standard solutions of 4.0 and 7.0. Results should be identical to those obtained prior to leaving the office. Document results in water lab QC log book.

e. Reduce water flow to permit filling whirl-pac bag without splashing. Fill bags to at least 100 ml. Do not allow water to overflow and be sure to leave an airspace for mixing purposes.

(1) If bag drops or contents are spilled, discard the bag and fill another bag.

(2) Until further notice -- two samples from each site are required for bacteriological analysis.

(3) One additional sample for fluoride analysis is required at those sites listed in SGPB OI 161-12, Attachment 6.

f. Place samples in an iced cooler for storage during transport to the laboratory. If the samples are not going to be analyzed immediately upon return to the lab, store them in the refrigerator. All samples must be run within 30 hours of collection. If the 30 hour deadline expires before the samples are run, they must be rejected and re-collected.

3. Analysis:

a. Until further notice, both the membrane filter and Colilert methods will be used for bacteriological examination. These samples will be compared and reported together until the Colilert method is approved for use by the State of Maryland.

b. Perform QC checks on equipment and verify QC checks on all supplies IAW the EPA Manual for the Certification of Laboratories Analyzing Drinking Water, Criteria and Procedures, Quality Assurance, Third Edition, Chapter V, (SGPB OI 161-12 Attachment 8). Document all QC results in the water lab QC log book on the applicable forms.

c. Membrane Filter Analysis of Samples:

(1) Wash hands, disinfect lab bench (using bleach) and wipe dry.

(2) Label petri dish (site, pH, chlorine, and time of collection) with a grease pencil.

(3) Loosen petri dish lid.

(4) Sterilize forceps by dipping in methanol and flame.

(5) Place autoclaved filter pad in the bottom of the petri dish using sterilized forceps.

(6) Break ampuled M-Endo Media in 2 ml sterile vials and deliver onto the media pad. Make sure you set lid down on its back to prevent contamination.

(7) Upon completion of adding media to filter pad place lid back on petri dish loosely and allow for filter pad to become saturated with media.

(8) Pour off excess media (should only be a drop or two, don't shake), do not set lid down.

(9) Assemble filtration apparatus and check for vacuum.

(10) Remove sterile funnel assembly base from bag and place in the top of the evacuation flask. Hold funnel in one hand and proceed to the next step.

(11) Remove forceps from the methanol, flame and let cool.

(12) Remove a filter from the sterile pack and reseal the pack (filters have grids on them).

(13) Place filter (grid up) centered on filter assembly base.

(14) Return forceps to methanol.

(15) Place filter assembly funnel on base and join both portions of the filter assembly with clamp.

(16) Place approximately 10 ml of dilution/rinse water in the funnel and turn on vacuum suction pump to check for leaks.

(17) Turn off vacuum and release residual vacuum from evacuation flask by pulling vacuum hose away from vacuum outlet.

(18) Pour 100 ml of dilution rinse water into the funnel to be used as the control.

(19) Turn on vacuum and rinse funnel with approximately 20-30 ml of dilution water three times and then turn off vacuum.

(20) Remove funnel and in one hand, remove forceps from methanol, flame and let cool.

(21) Carefully remove filter from the filter base with forceps, place funnel back on base. Open petri dish (do not set lid down) and place filter on the media pad. Tightly close petri dish. This should be labeled C-1 for control 1.

(22) Allow filter to absorb media and place in the incubator.

(23) Place a new filter on filter assembly base for each sample. Thoroughly mix samples prior to filtration. Pour 100 ml for sample into funnel assembly and repeat steps 11 through 22 with the exception of 17 and 18. Each filter should be placed into the appropriate petri dish after filtering.

(24) Control samples must be run before and after running samples collected from sites. Controls should be marked C-1 for initial control and C-2 for last control on each petri dish.

(25) A positive sample is ran after control C-2. After positive control, run a final control (C-3) to verify rinse technique. The media used for the positive sample is obtained from the east side WSSC vault.

d. Clean-up Procedures:

(1) The funnel assembly should be cleaned with soap and water and final rinsed with distilled water, then placed in a sterilizer bag to be sterilized before reuse.

(2) The lab area should be disinfected at the end of clean-up.

(3) After the petri dishes have been read, they are wrapped in aluminum foil and autoclaved at 121 degrees Celsius for 30 minutes prior to disposal into the trash.

e. Colilert P/A method:

(1) Thoroughly wash hands and work surface prior to performing tests.

(2) Remove a sterile reaction vessel from its wrapper and label on the cap the sample location, pH, chlorine, date and time.

(3) Shake water sample vigorously.

(4) Uncap sterile vessel, leaving cap inverted on the clean table top.

(5) Aseptically pour 100 ml of water sample into the sterile reaction vessel.

(6) Aseptically add the contents of 1 unit tube of Colilert P/A reagent to the reaction vessel.

(7) Without touching the interior surface of the cap, replace the cap on the vessel and tighten. Mix vigorously to dissolve the reagent.

(8) Place the vessel in the incubator at 35-37 degrees Celsius for 24 to a maximum of 28 hours.

f. Fluoride:

(1) The HACH DREL/5 Kit is used for fluoride analysis.

(2) Follow the instructions on page 2-113 of the HACH Water Analysis Handbook, 1985 Edition (SGPB OI 161-12, Attachment 9).

g. If any routine or repeat sample is total coliform positive, determination for fecal or E.Coli presence must be made on the positive sample. Additionally, repeat sampling must be accomplished IAW AFR 161-44.

(1) Membrane Filter Technique: Remove the membrane containing the total coliform colonies from the substate with a sterile forceps and carefully curl and insert the membrane into a tube of EC medium. Gently shake the

inoculated EC tubes to ensure adequate mixing and incubate in a waterbath at 44.5 ± 0.2 degrees Celsius for 24 ± 2 hours. Gas production of any amount in the inner fermentation tube of the EC medium indicates a positive fecal coliform test.

(2) Colilert P/A Method: Gently shake or rotate the yellow Colilert vessel to insure that all organisms are resuspended. With a sterile loop 3mm in diameter, transfer one loopful of culture to an EC tube with MUG Media. Gently shake the inoculated EC tube to ensure adequate mixing and incubate in a waterbath at 44.5 ± 0.2 degrees Celsius for 24 ± 2 hours. Gas production of any amount in the inner fermentation tube of the EC medium indicates a positive fecal coliform test.

4. Reporting: Record all results in the sampling log and give to the Lab Supervisor for inspection. The Lab Supervisor will initial and date the log upon review.

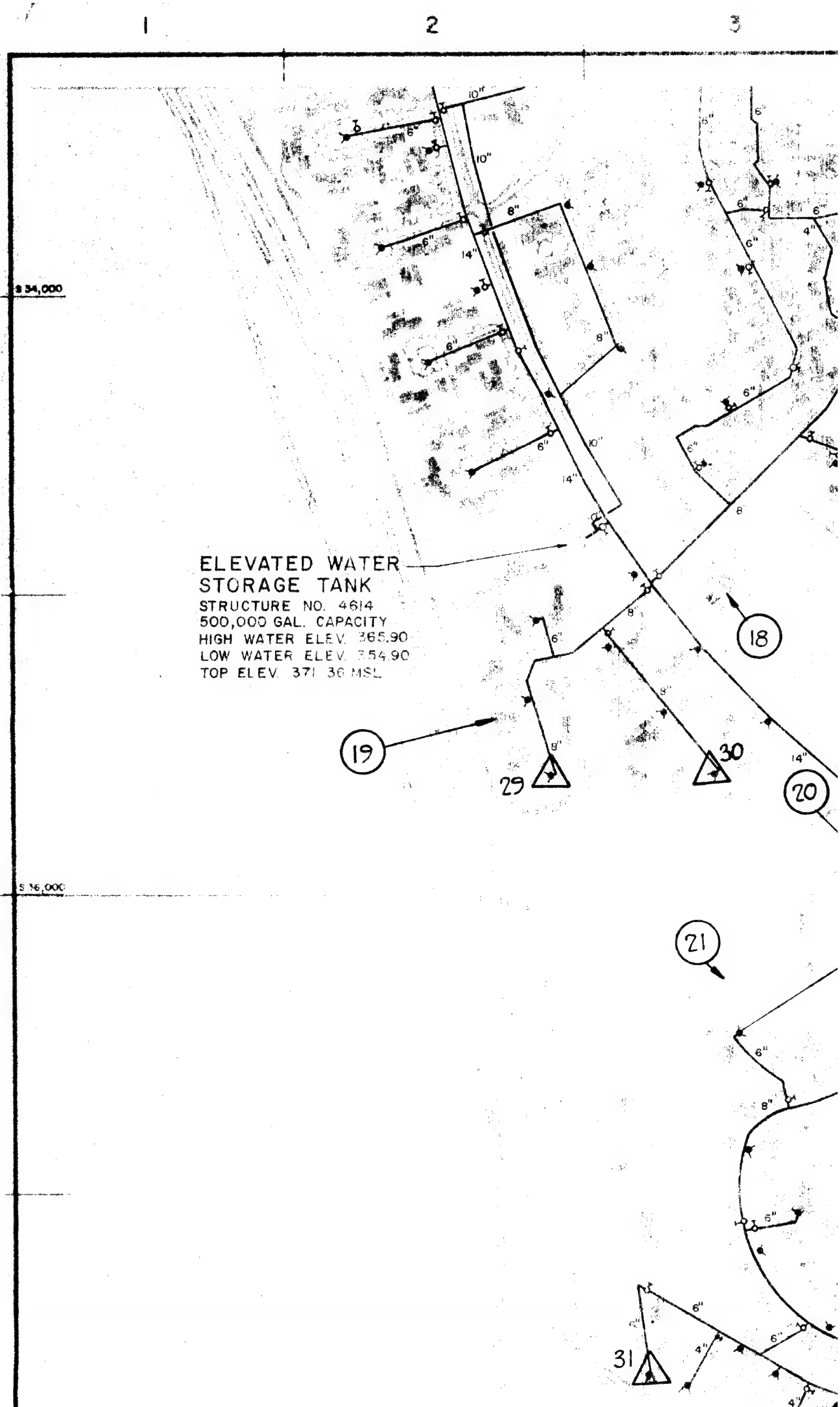
a. All positive samples must be reported to the Lab Supervisor and Chief Engineer immediately. The Chief Engineer will notify SGP, and the State IAW HQ USAF/SGP letter, Safe Drinking Water Act Requirements for Public Notification, 5 May 1989 (SGPB OI 161-12, Attachment 10).

b. A system that fails to comply with a coliform monitoring requirement, including sanitary survey requirements, must report the monitoring violation, and notify the public IAW HQ USAF/SGP letter, Safe Drinking Water Act Requirements for Public Notification, 5 May 1989 (SGPB OI 161-12, Attachment 10).

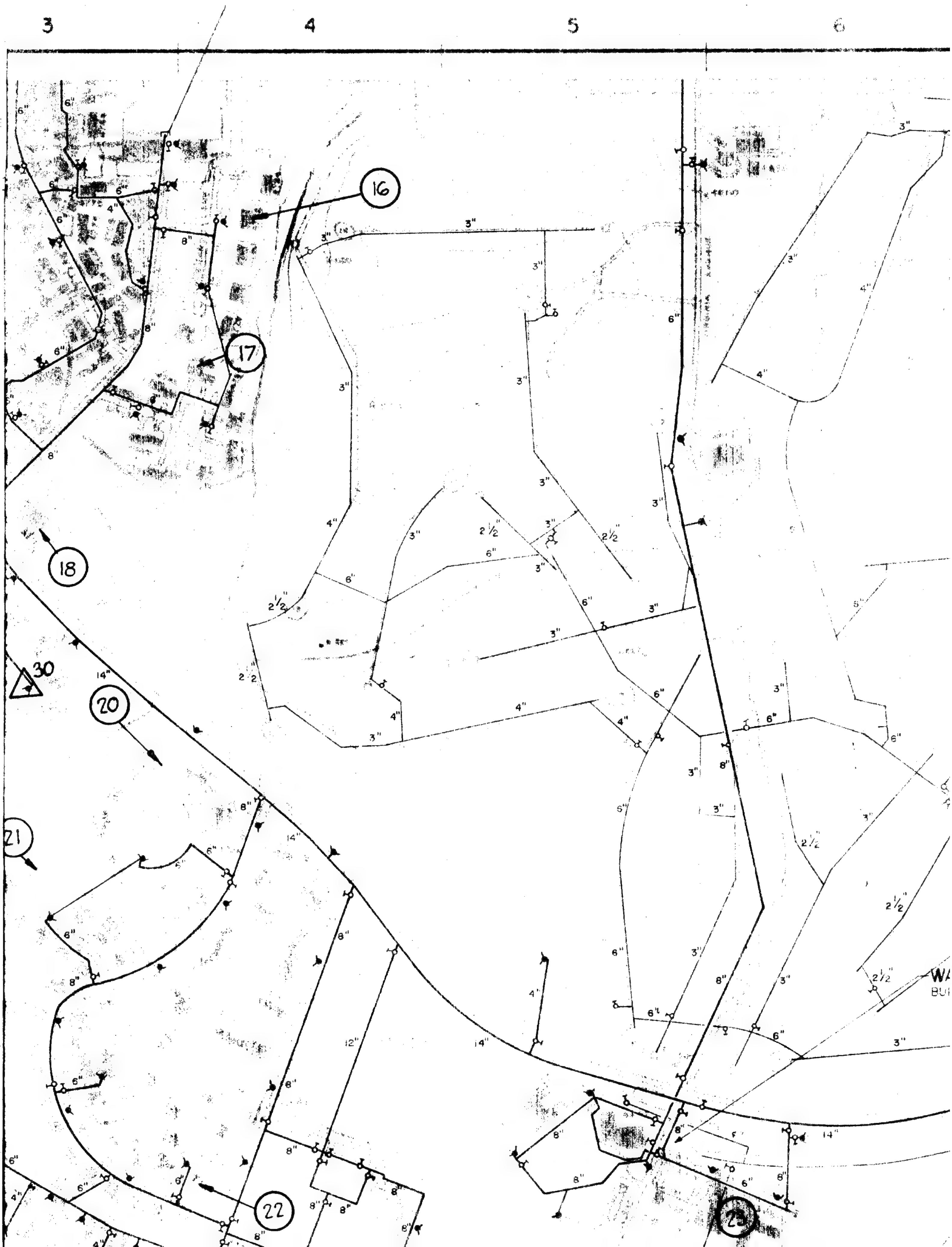
APPENDIX E

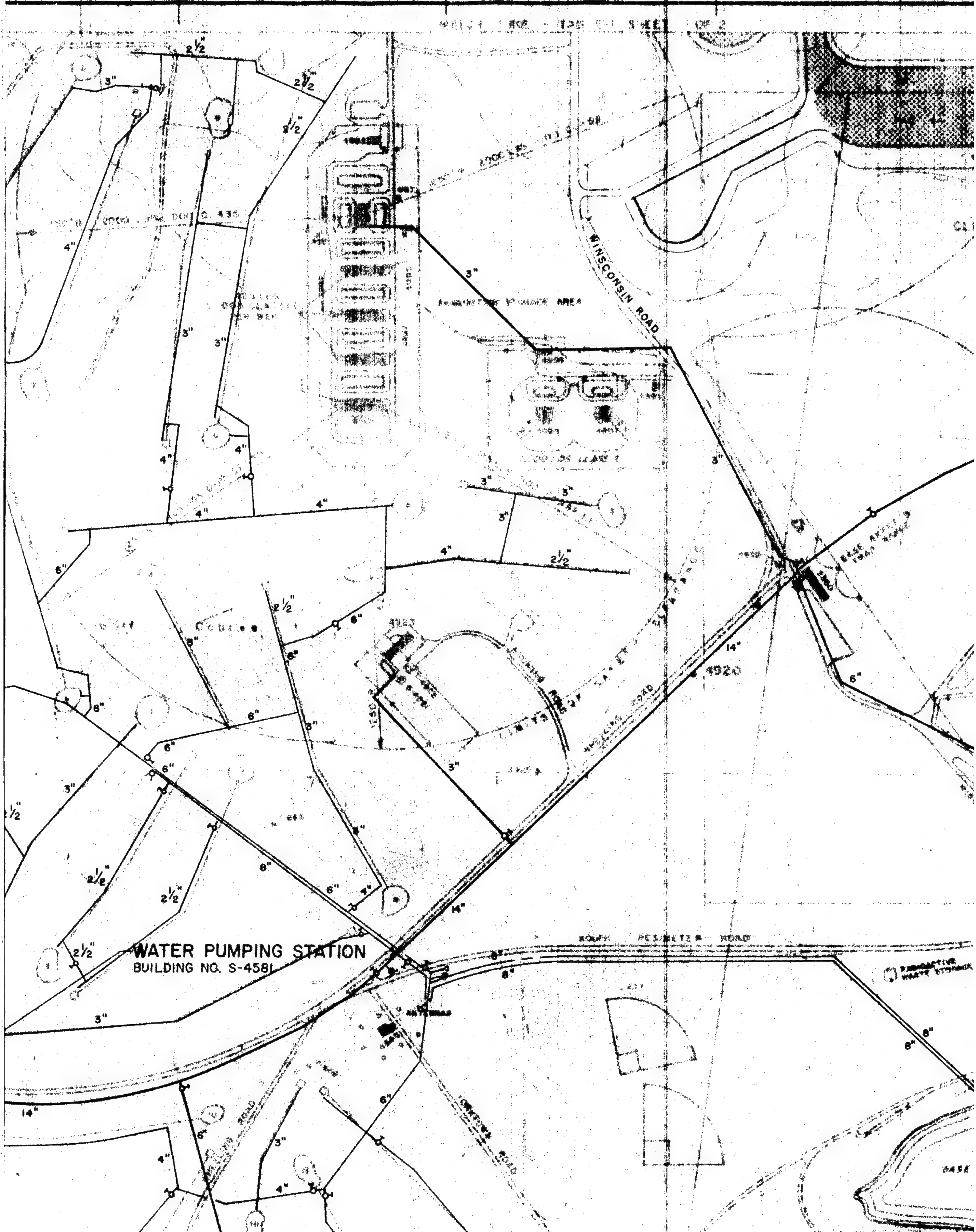
DRAWINGS

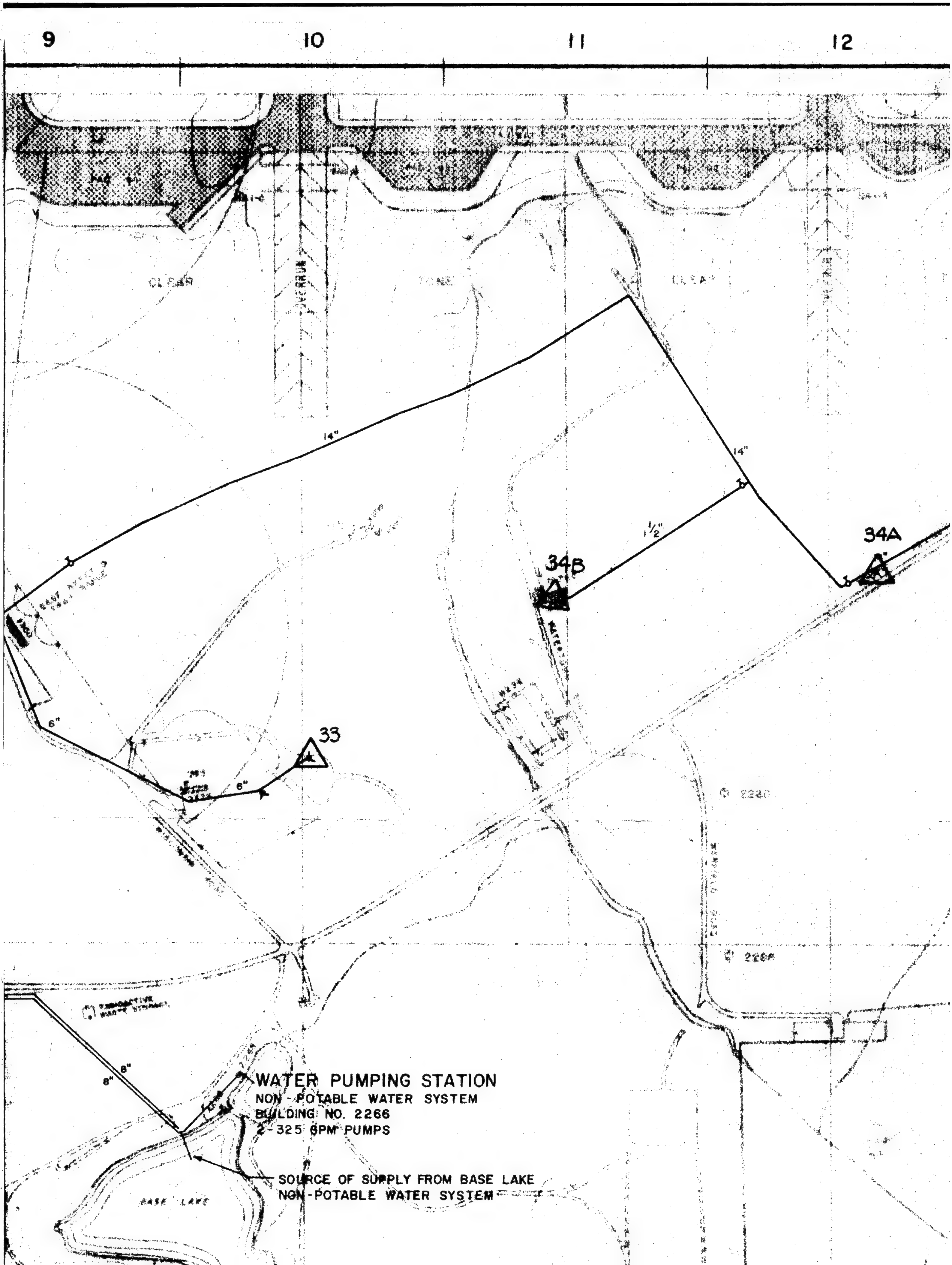
This appendix contains the Master Plan of Andrews AFB Water Supply System.

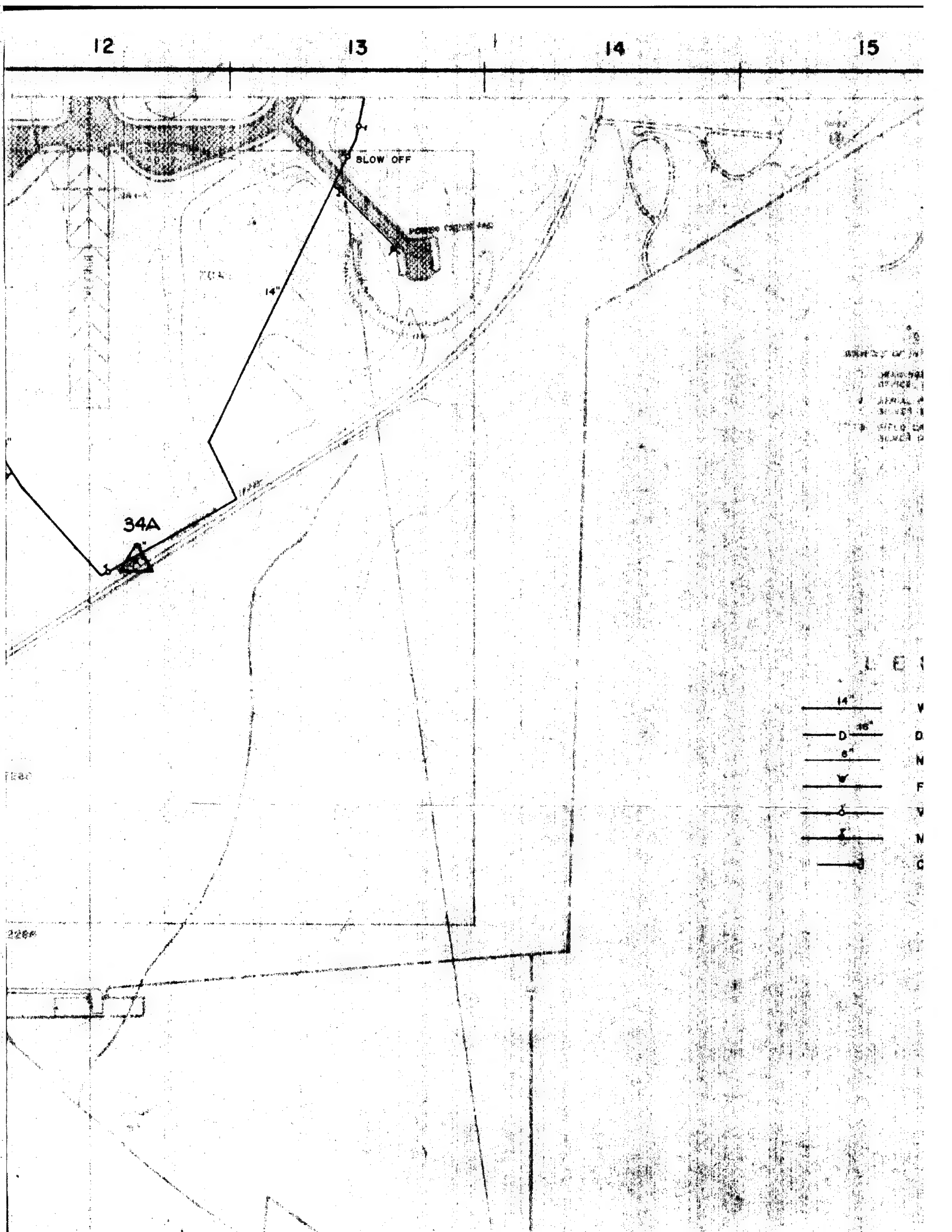


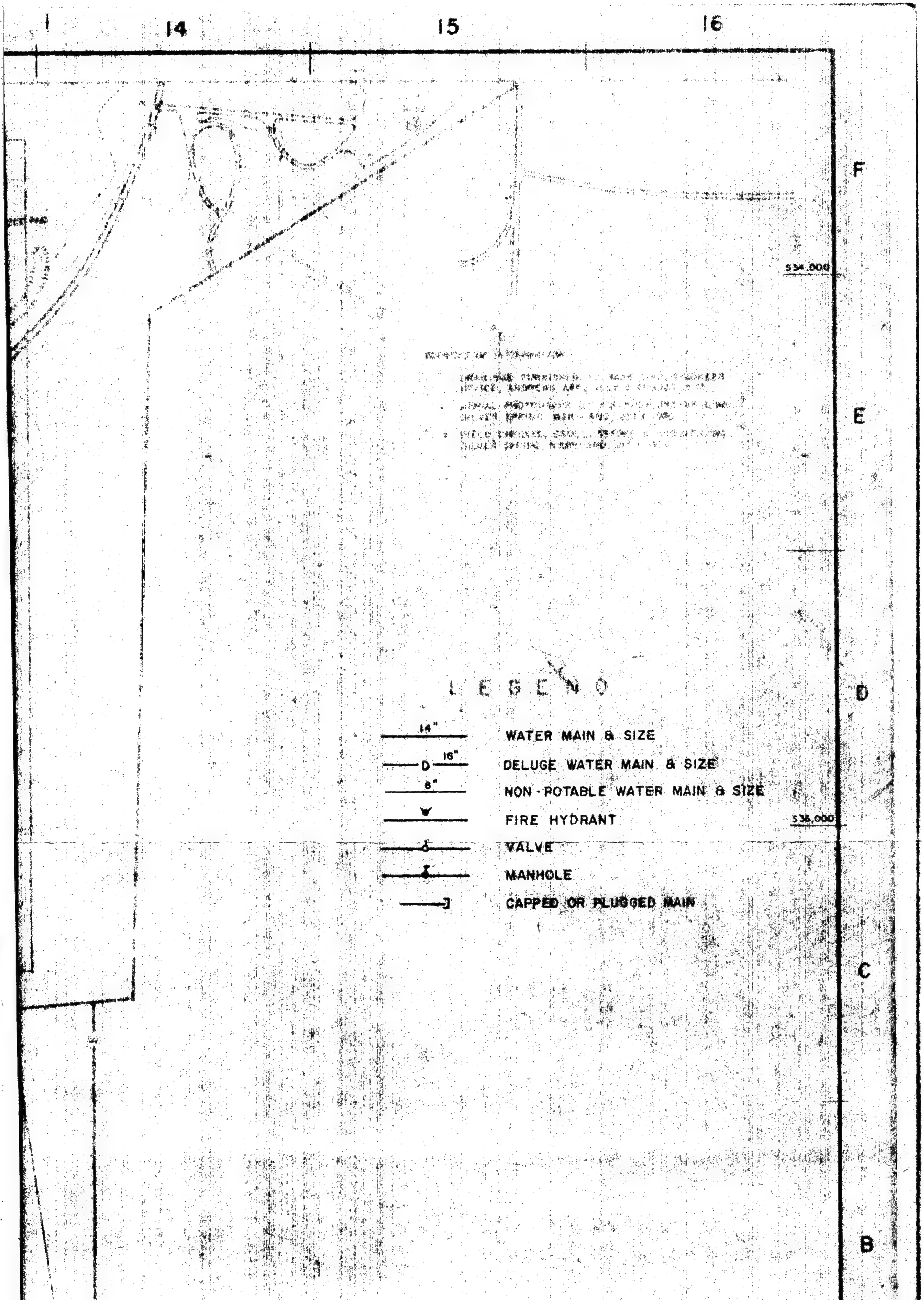
1
2
3
F
E
D
C
B
834,000
836,000
ELEVATED WATER
STORAGE TANK
STRUCTURE NO. 4614
500,000 GAL. CAPACITY
HIGH WATER ELEV. 365.90
LOW WATER ELEV. 354.90
TOP ELEV. 371.36 MSL
18
19
20
21
29
30
31
10"
8"
6"
14"
4"


3
4
5
6
16
17
18
20
21
22
30

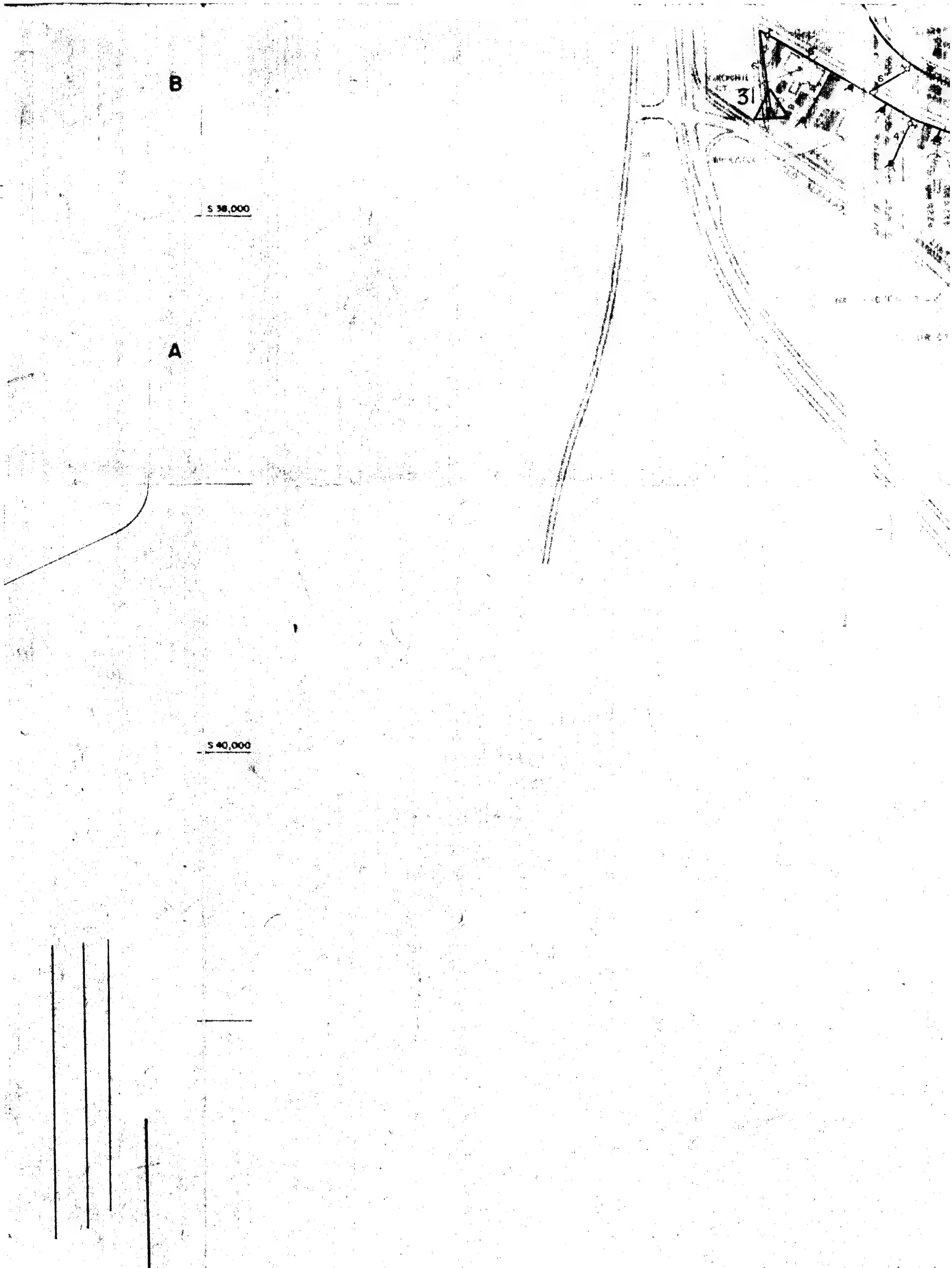

WATER PUMPING STATION
BUILDING NO. S-4581
WINSCONSIN ROAD
SOUTH PERIMETER ROAD
4920
14"
8"
6"
4"
3"
2 1/2"

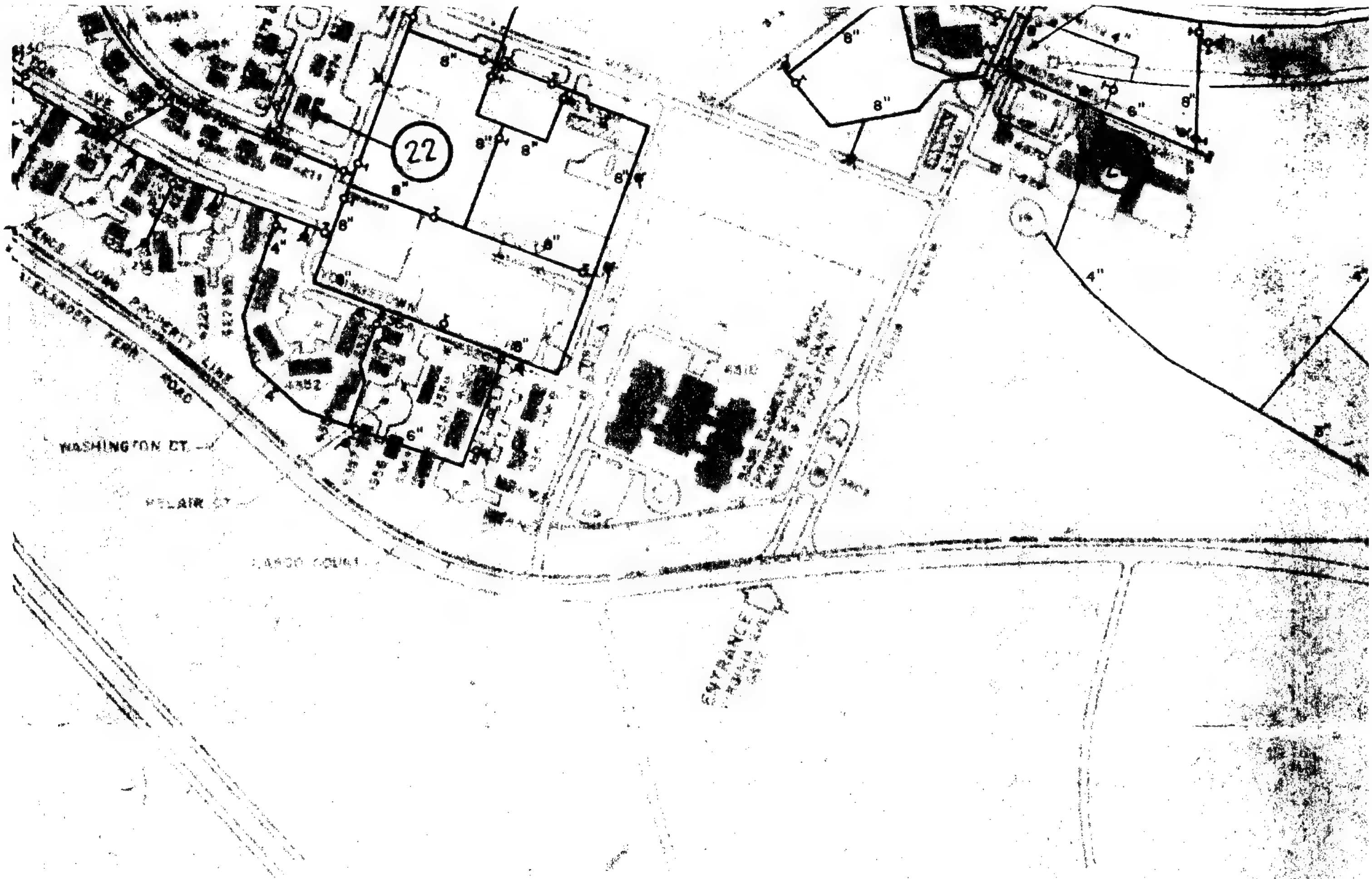

9
10
11
12
CLEAR
OVERRUN
CLEAR
14"
14"
1½"
34A
34B
33
6"
6"
8"
8"
WATER PUMPING STATION
NON-POTABLE WATER SYSTEM
BUILDING NO. 2266
2-325 GPM PUMPS
SOURCE OF SUPPLY FROM BASE LAKE
NON-POTABLE WATER SYSTEM
BASE LAKE
RADIOACTIVE WASTE STORAGE

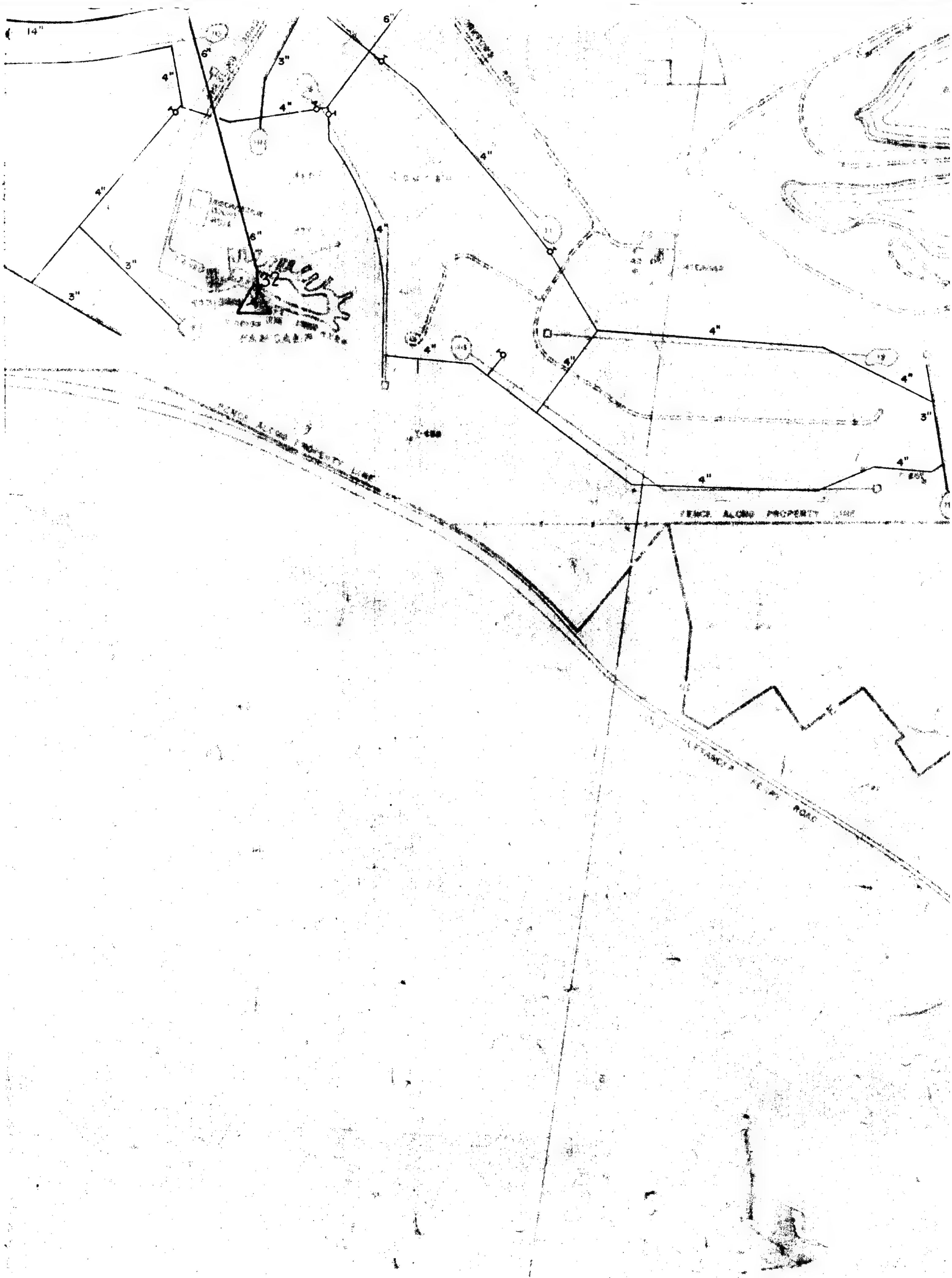

12
13
14
15
BLOW OFF
14"
34A
14"
D
8"



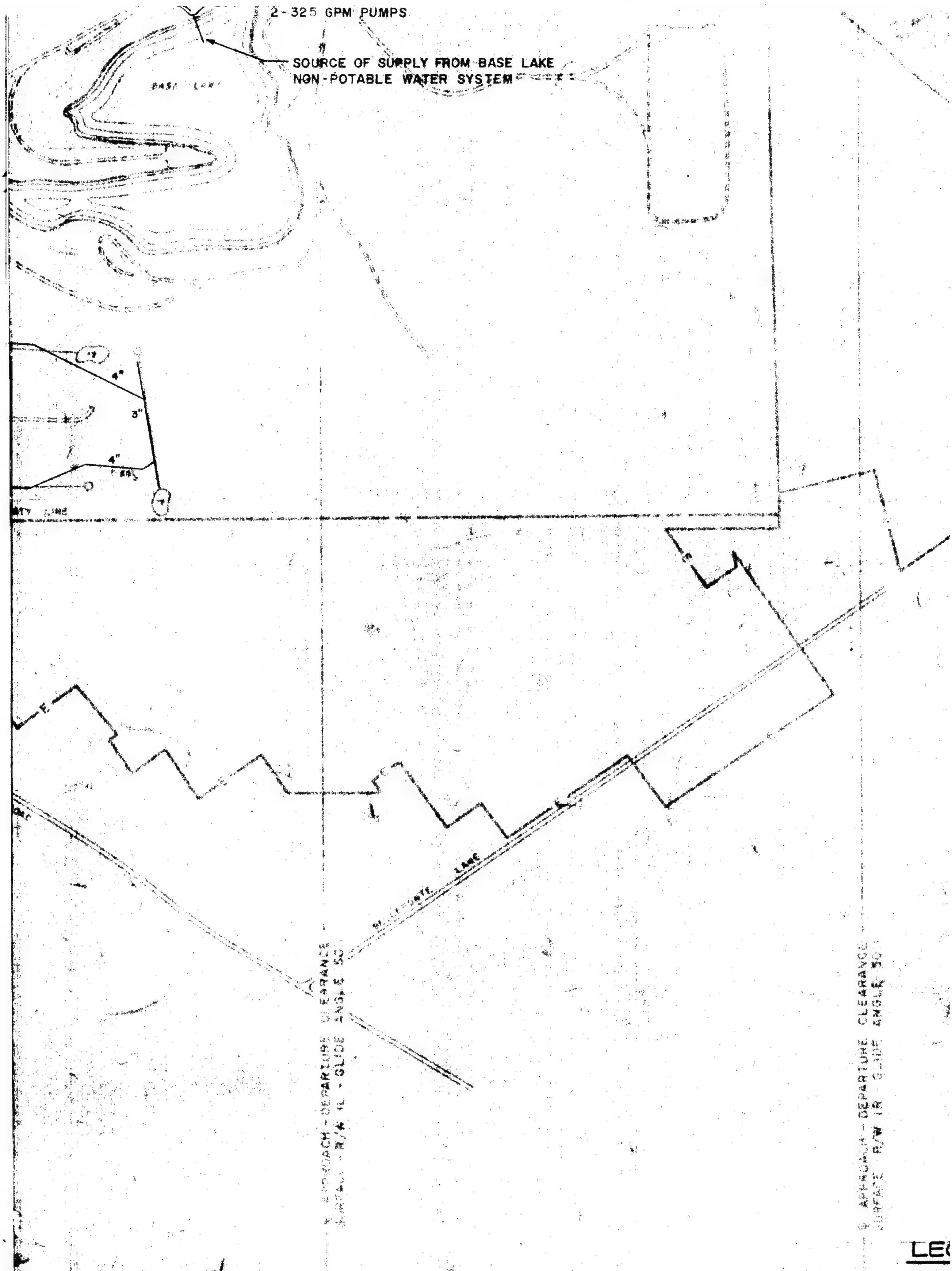
14
15
16
F
E
D
C
B
534,000
536,000
LEGEND
14"
WATER MAIN & SIZE
D 16"
DELUGE WATER MAIN & SIZE
8"
NON-POTABLE WATER MAIN & SIZE
FIRE HYDRANT
VALVE
MANHOLE
CAPPED OR PLUGGED MAIN


B
S 38,000
A
S 40,000
31

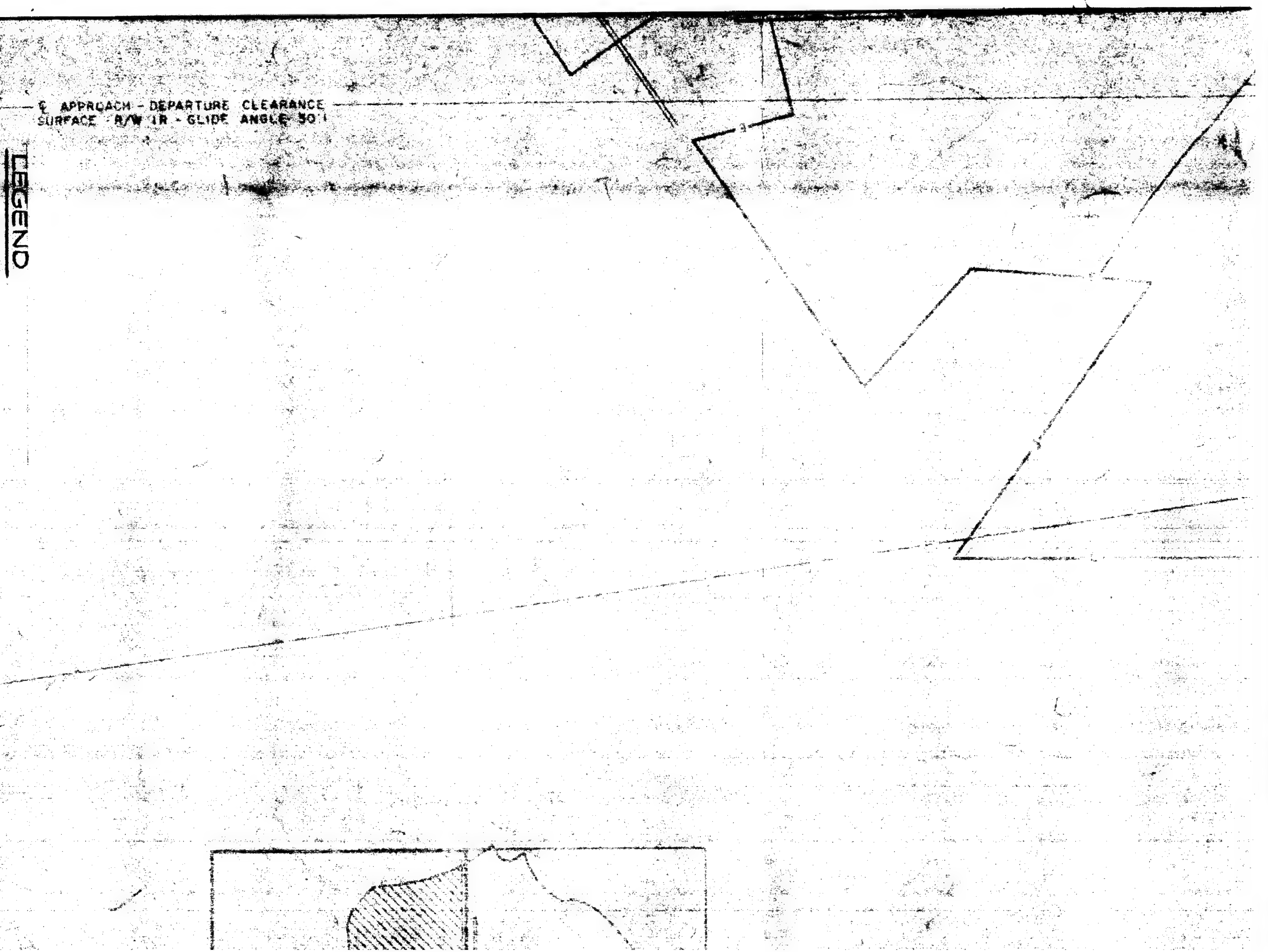

22
WASHINGTON CT.
ALEXANDER FERRY ROAD
FENCE ALONG PROPERTY LINE
ENTRANCE

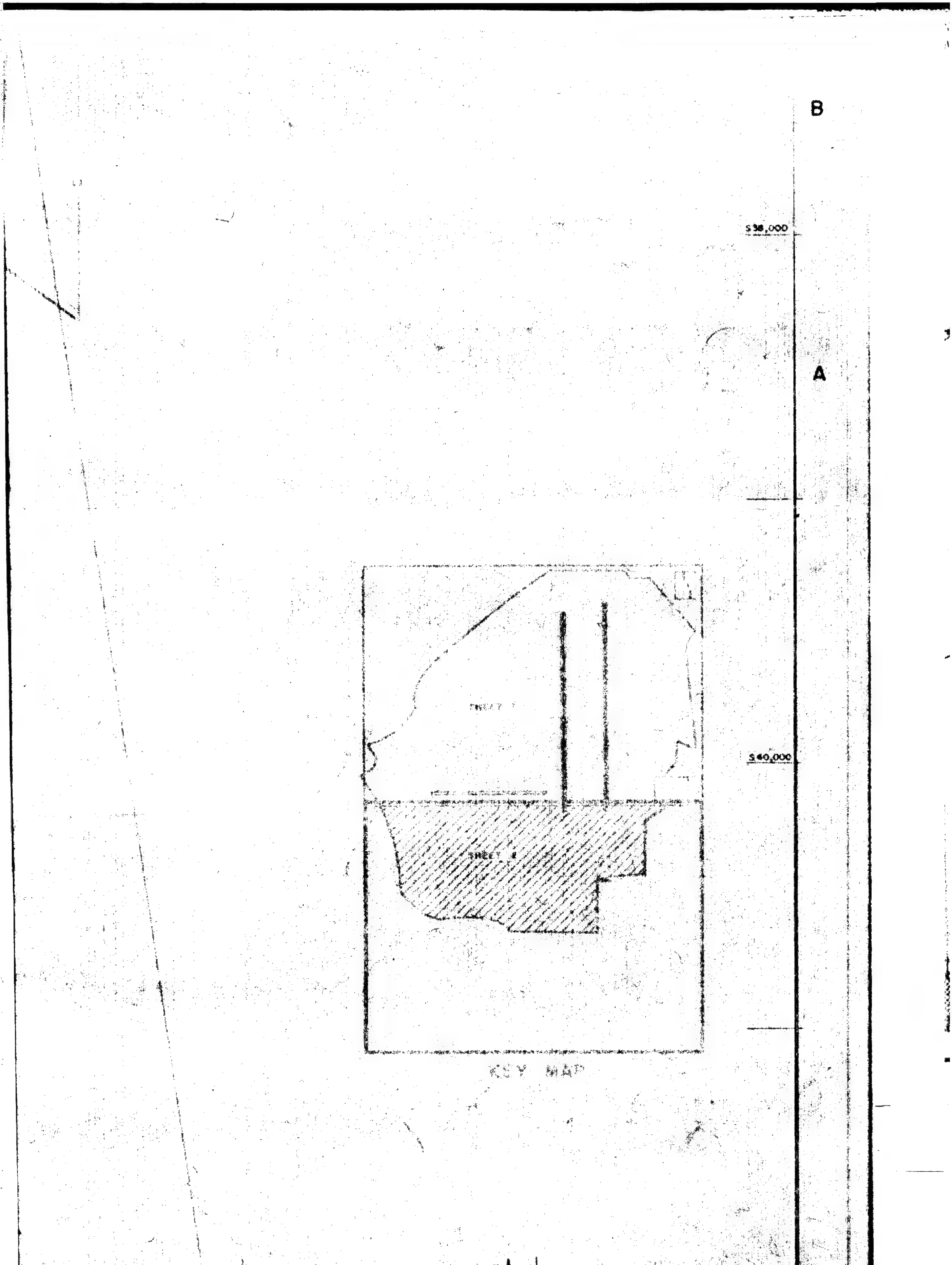


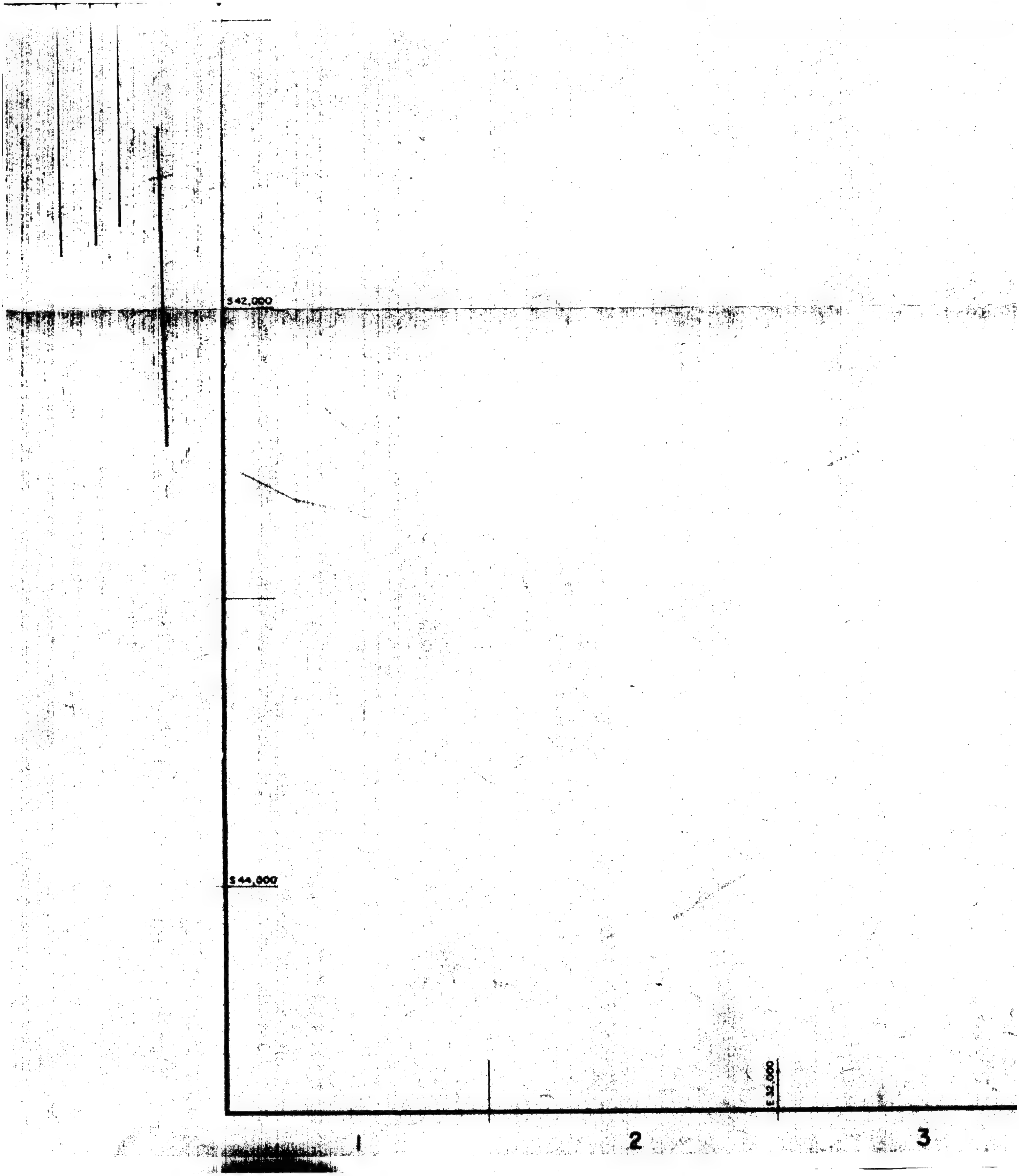
14"
6"
3"
4"
3"
FENCE ALONG PROPERTY LINE



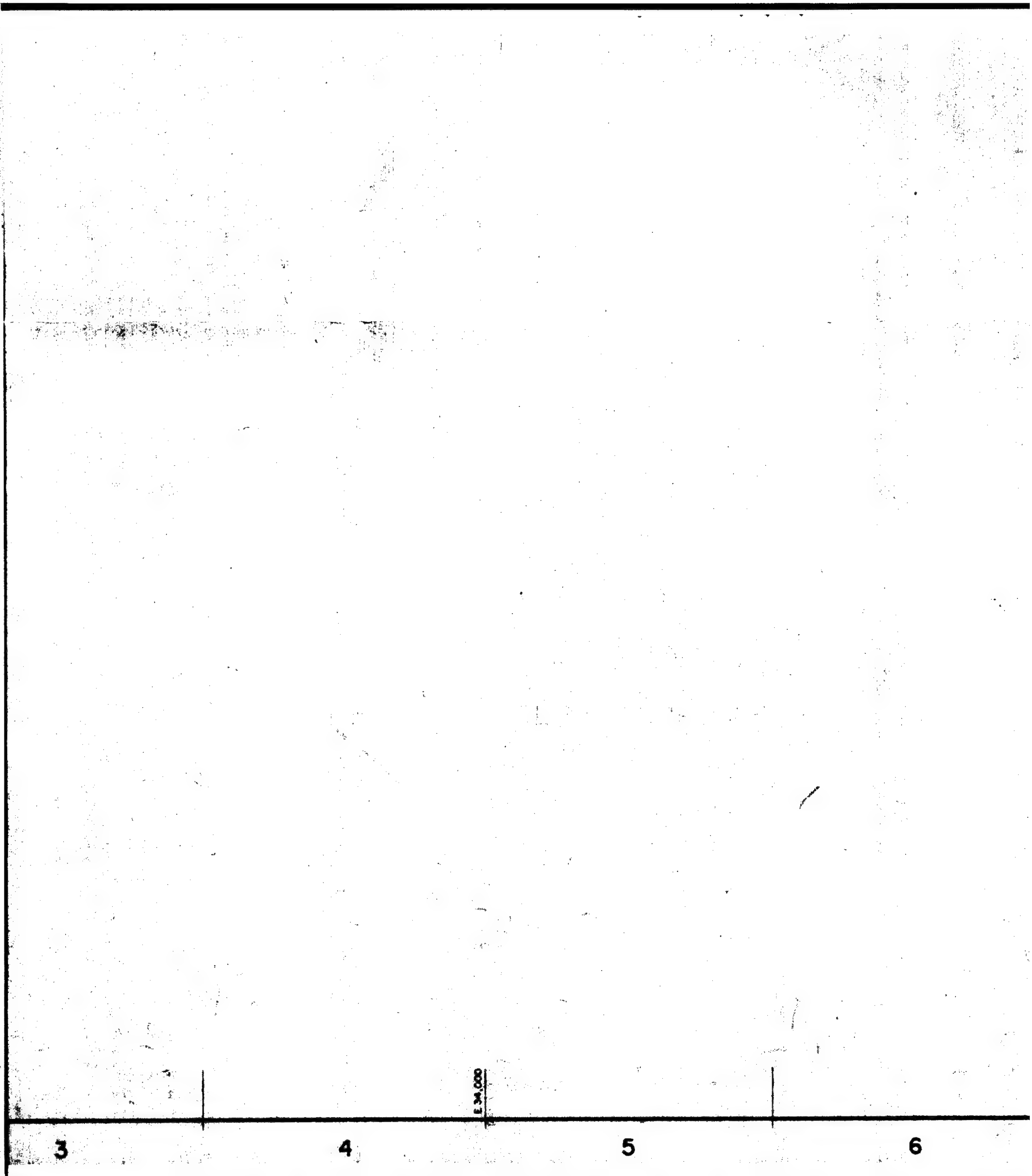
2-325 GPM PUMPS
SOURCE OF SUPPLY FROM BASE LAKE
NON-POTABLE WATER SYSTEM
4"
3"
4"
APPROACH - DEPARTURE CLEARANCE


LEGEND
℄ APPROACH - DEPARTURE CLEARANCE
SURFACE R/W 1R - GLIDE ANGLE 50:1


B
S38,000
A
S40,000
KEY MAP



$42,000
$44,000
$32,000
1
2
3


E 34,000
3
4
5
6

E 36,000

E 38,000

6 7 9

LEGE

2

30

DESIGN GCG	
DRAWN AMP	
CHECKED GCG	
PROJECT ENGINEER DEK	

SAMPLING

Loveton Center
15 Loveton Circl
Sparks, Maryland
(410) 771-4950

E 40,000

9 10 11 12

LEGEND

(2) LOCATIONS SAMPLED FOR COLIFORMS AND RESIDUAL CHLORINE

30 △ LOCATIONS SAMPLED FOR RESIDUAL CHLORINE.

GRAF
AIRFIELD
CONTOU

1	30SEP91	ANNU
REV	DATE	DE

DEPARTMEN
DIRECTORATE OF CIVIL EN

MAST
WATER
ANDREV
CAMP SI

SCALE 1" = 400' DA
MASTER PLANNING DIRECTIVE
GROLL, ASTORE & R
ARCHITECTS & URBAN DESIGNERS -

ANDREWS AIR FORCE BASE
CAMP SPRINGS, MARYLAND

SAMPLING LOCATIONS FOR COLIFORMS AND CHLORINE

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

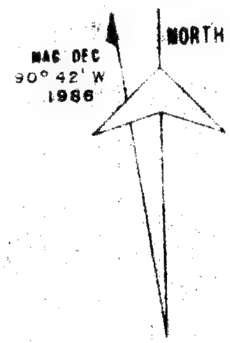
BALTIMORE
CHICAGO
LINCOLN
NEW YORK
NEW JERSEY
ATLANTA
DALLAS
LOS ANGELES
SAN FRANCISCO

Loveton Center
15 Loveton Circle
Sparks, Maryland 21152
(410) 771-4950

DATE	DECEMBER, 1993
SCALE	AS SHOWN
PROJECT NO.	11206.95
SHEET NO.	1 OF 2

12 13 14 15

COLIFORMS
E.
RESIDUAL CHLORINE.



542,000

400 0 400 800

GRAPHIC SCALE IN FEET
AIRFIELD ELEVATION 281 FEET
CONTOUR INTERVAL 5 FEET

REV.	DATE	DESCRIPTION	INITIAL
1	30SEP91	ANNUAL REVISIONS	REH

DEPARTMENT OF THE AIR FORCE
DIRECTORATE OF CIVIL ENGINEERING DCS/P&R - WASHINGTON, D.C.

MASTER PLAN
WATER SUPPLY SYSTEM
ANDREWS AIR FORCE BASE
CAMP SPRINGS, MARYLAND

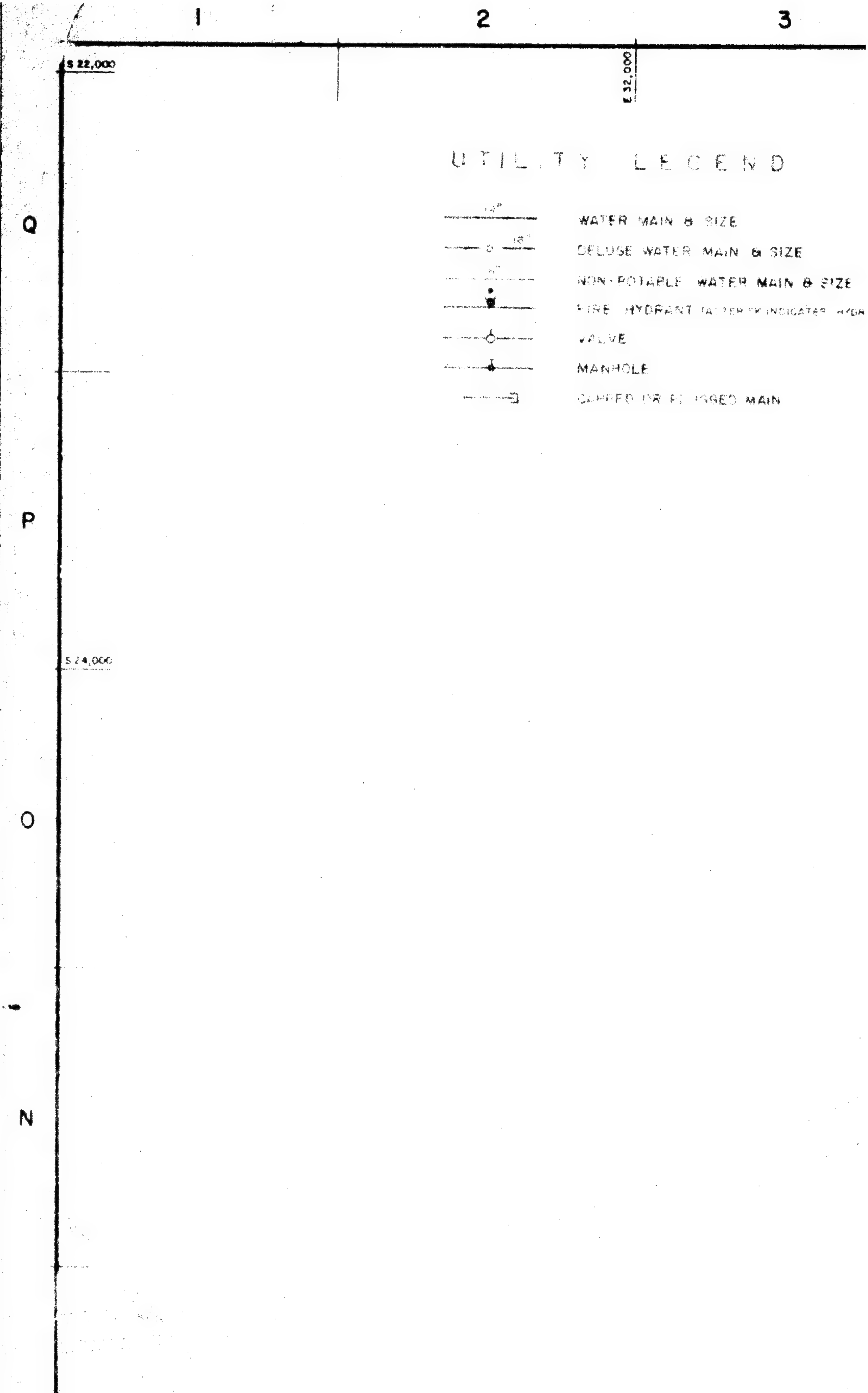
SCALE 1" = 400'	DATE DECEMBER 1970	
MASTER PLANNING DIRECTIVE AND 81-0		
GROLL, ASTORE & KOERNER, INC. ARCHITECTS & URBAN DESIGNERS - SILVER SPRING, MARYLAND		SHEET 1 OF 2

BASE
ID

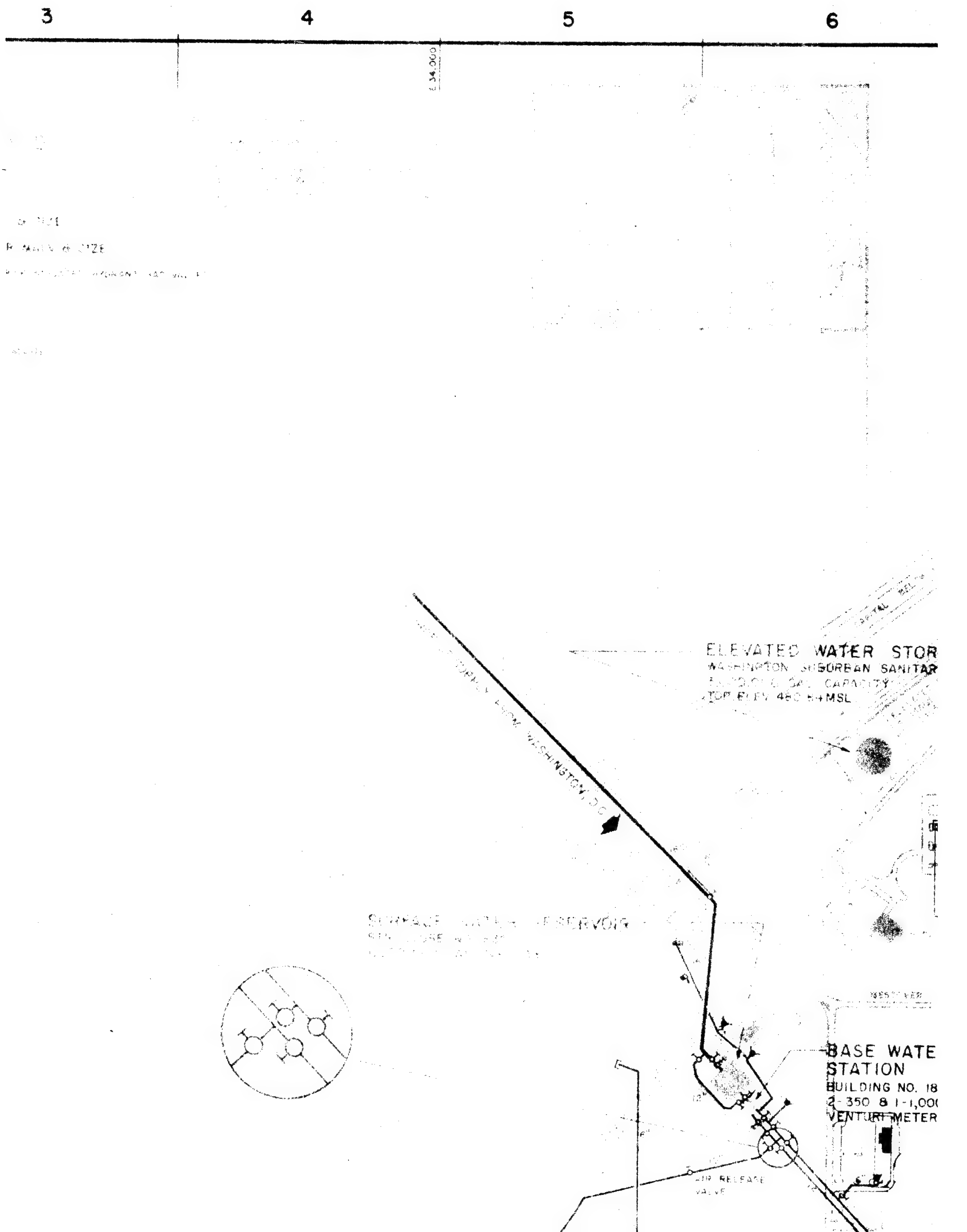
MS AND CHLORINE

DATE	DECEMBER, 1993
SCALE	AS SHOWN
PROJECT NO.	11206.95
SHEET NO.	1 OF 2

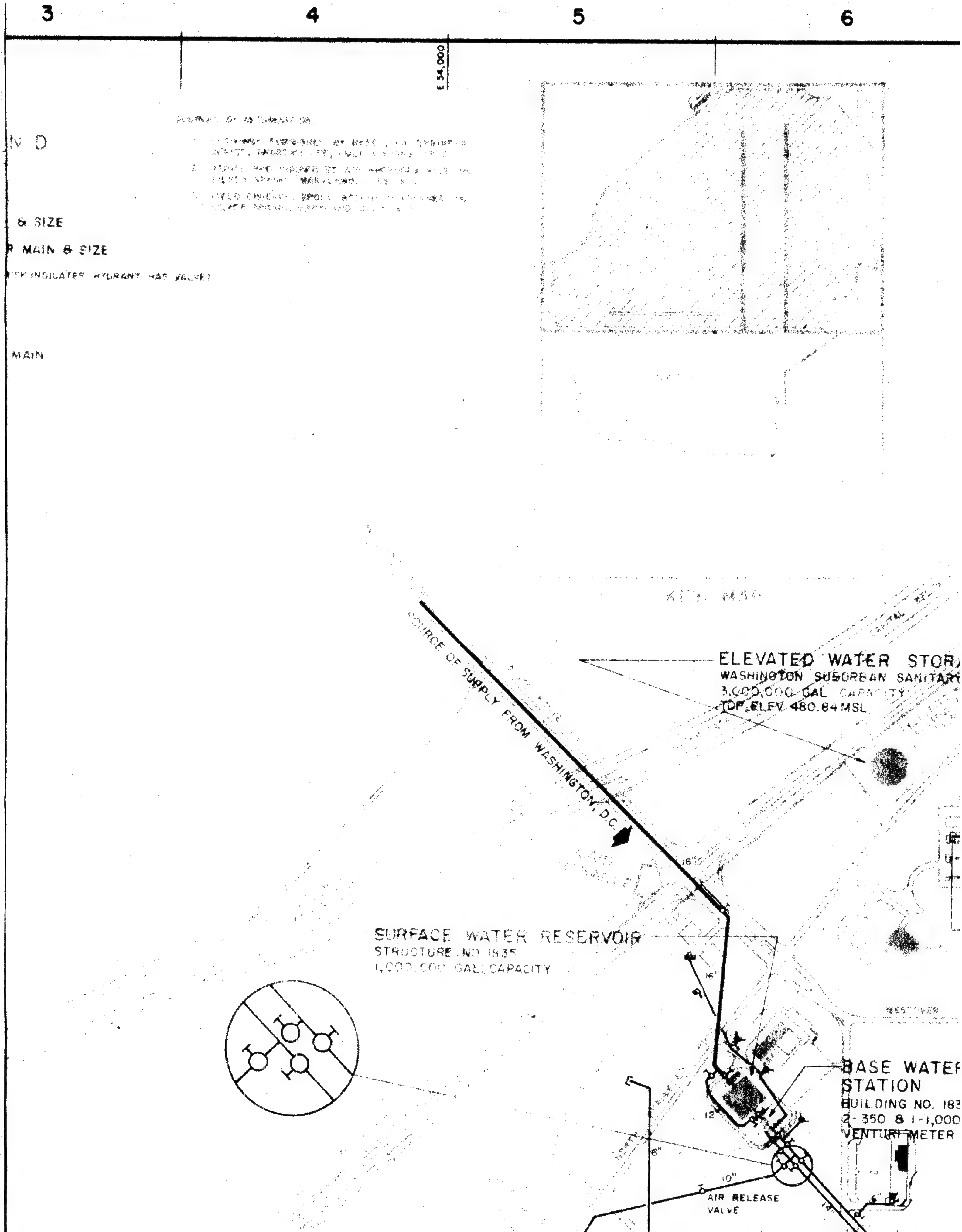
14 15 16



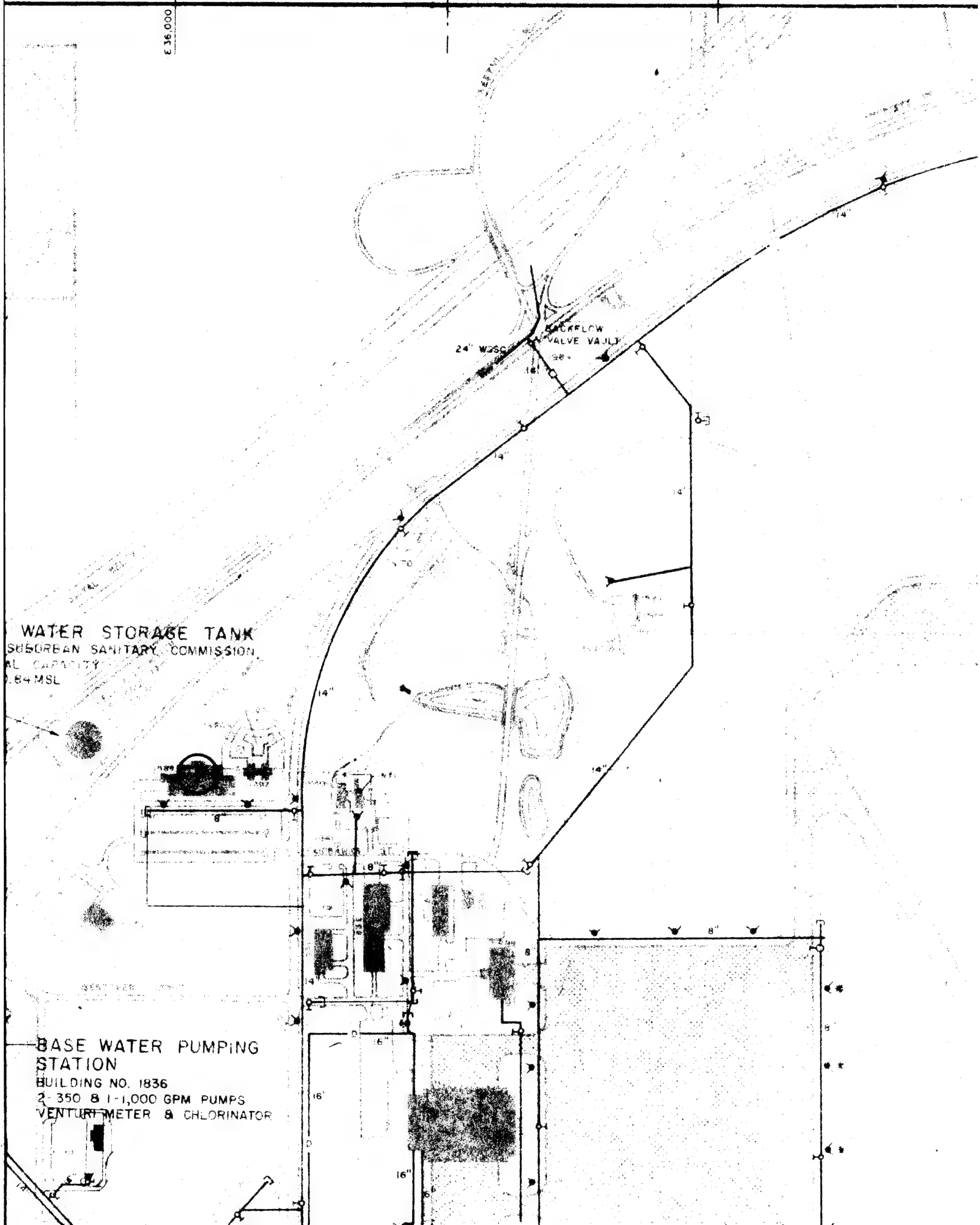
1
2
3
S 22,000
E 32,000
S 24,000
Q
P
O
N
UTILITY LEGEND
WATER MAIN & SIZE
DELUSE WATER MAIN & SIZE
NON-POTABLE WATER MAIN & SIZE
FIRE HYDRANT
VALVE
MANHOLE
MAIN

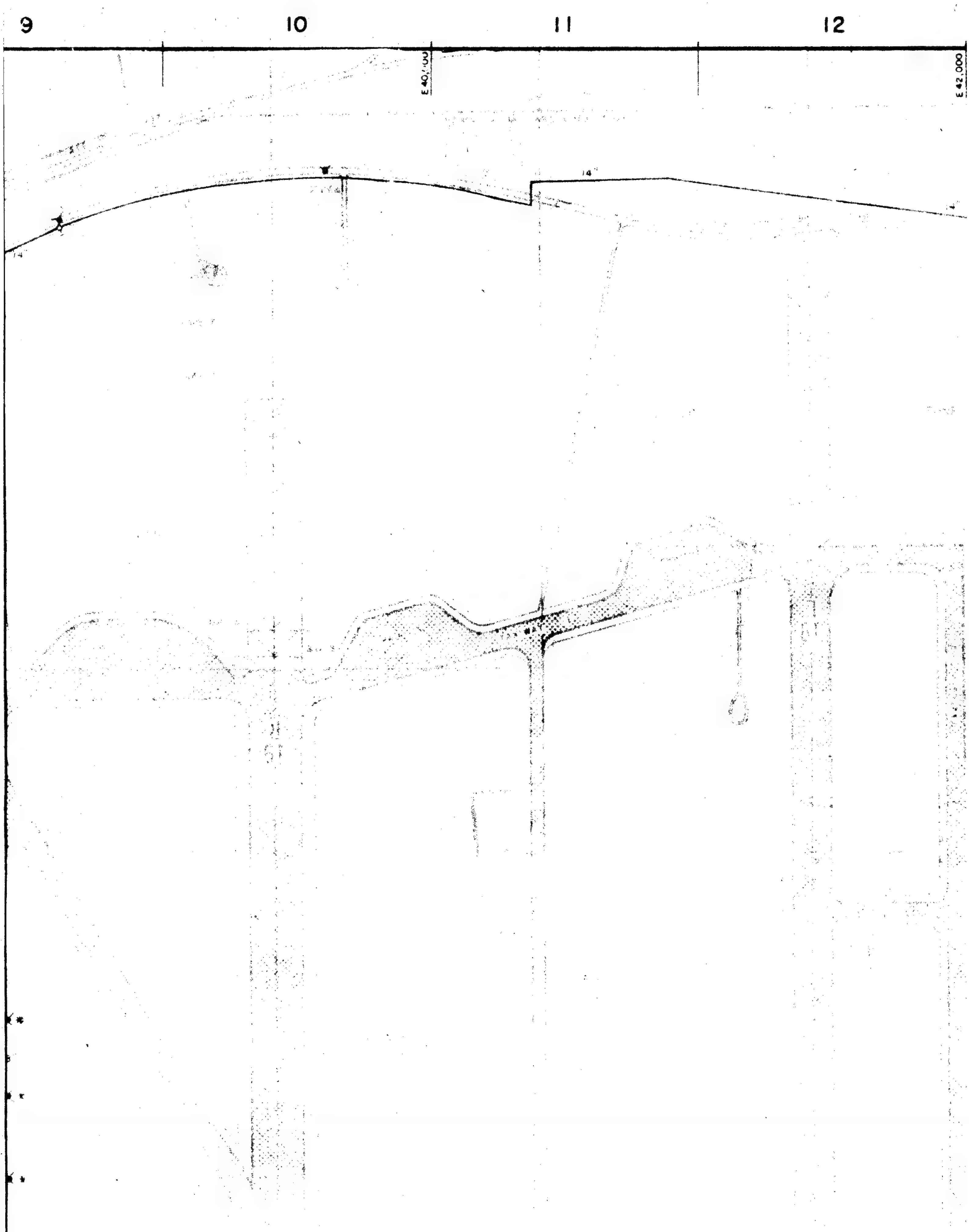


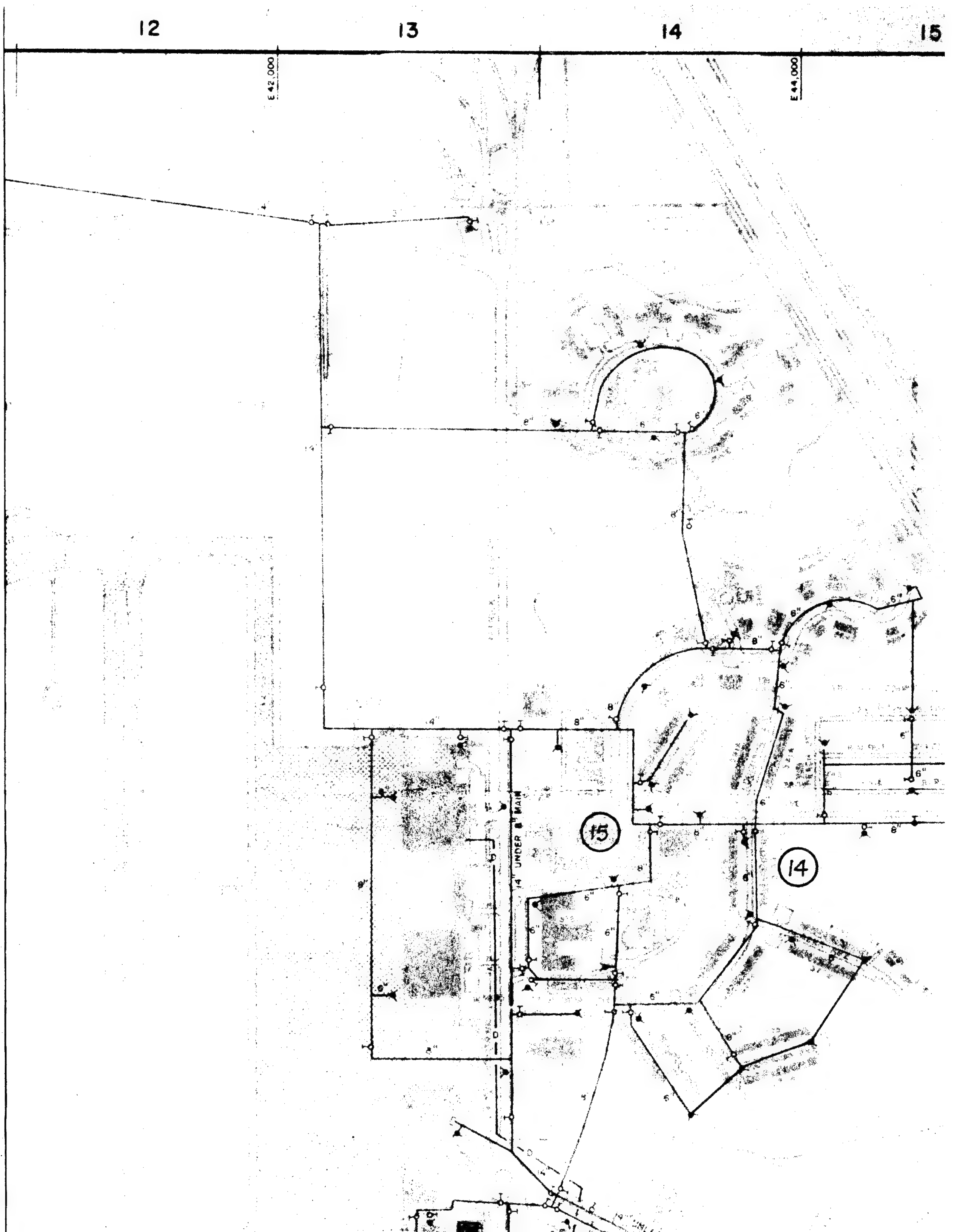
3
4
5
6
ELEVATED WATER STOR
SUBURBAN SANITAR
CAPACITY
MSL
BASE WATE
STATION
BUILDING NO. 18
2-350 & 1-1,00(
VENTURI METER
AIR RELEASE
VALVE



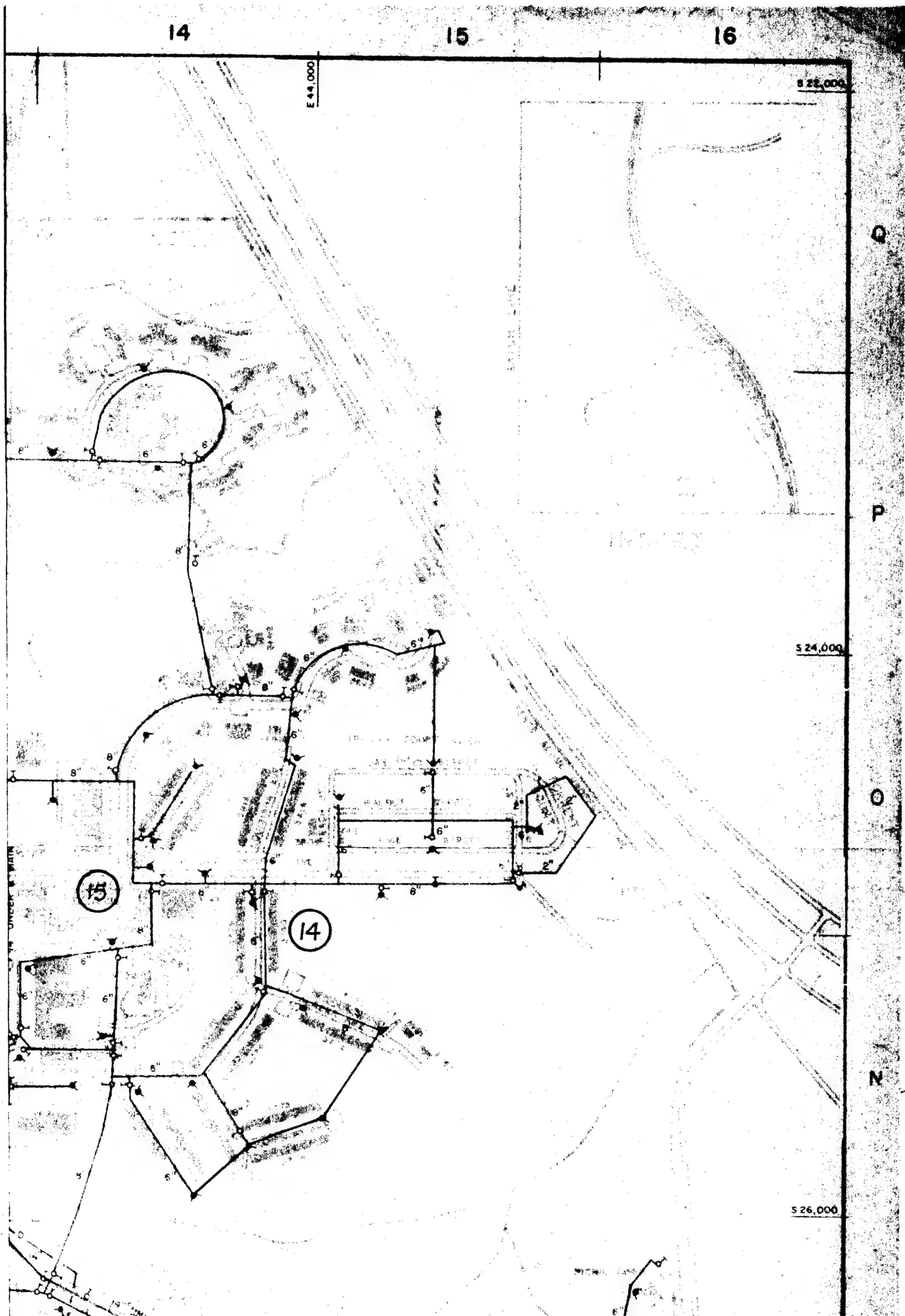
3
4
5
6
E 34,000
& SIZE
R MAIN & SIZE
MAIN
ELEVATED WATER STOR
WASHINGTON SUBURBAN SANITARY
3,000,000 GAL CAPACITY
TOP ELEV 480.84 MSL
SOURCE OF SUPPLY FROM WASHINGTON, D.C.
16"
SURFACE WATER RESERVOIR
STRUCTURE NO 1835
1,000,000 GAL CAPACITY
BASE WATER
STATION
BUILDING NO. 183
2-350 & 1-1,000
VENTURI METER
12"
6"
10"
AIR RELEASE
VALVE


E 36,000
BACKFLOW
VALVE VAULT
24" WSSC
14"
8"
16"
WATER STORAGE TANK
SUBURBAN SANITARY COMMISSION
.84 MSL
BASE WATER PUMPING
STATION
BUILDING NO. 1836
2-350 & 1-1,000 GPM PUMPS
VENTURI METER & CHLORINATOR

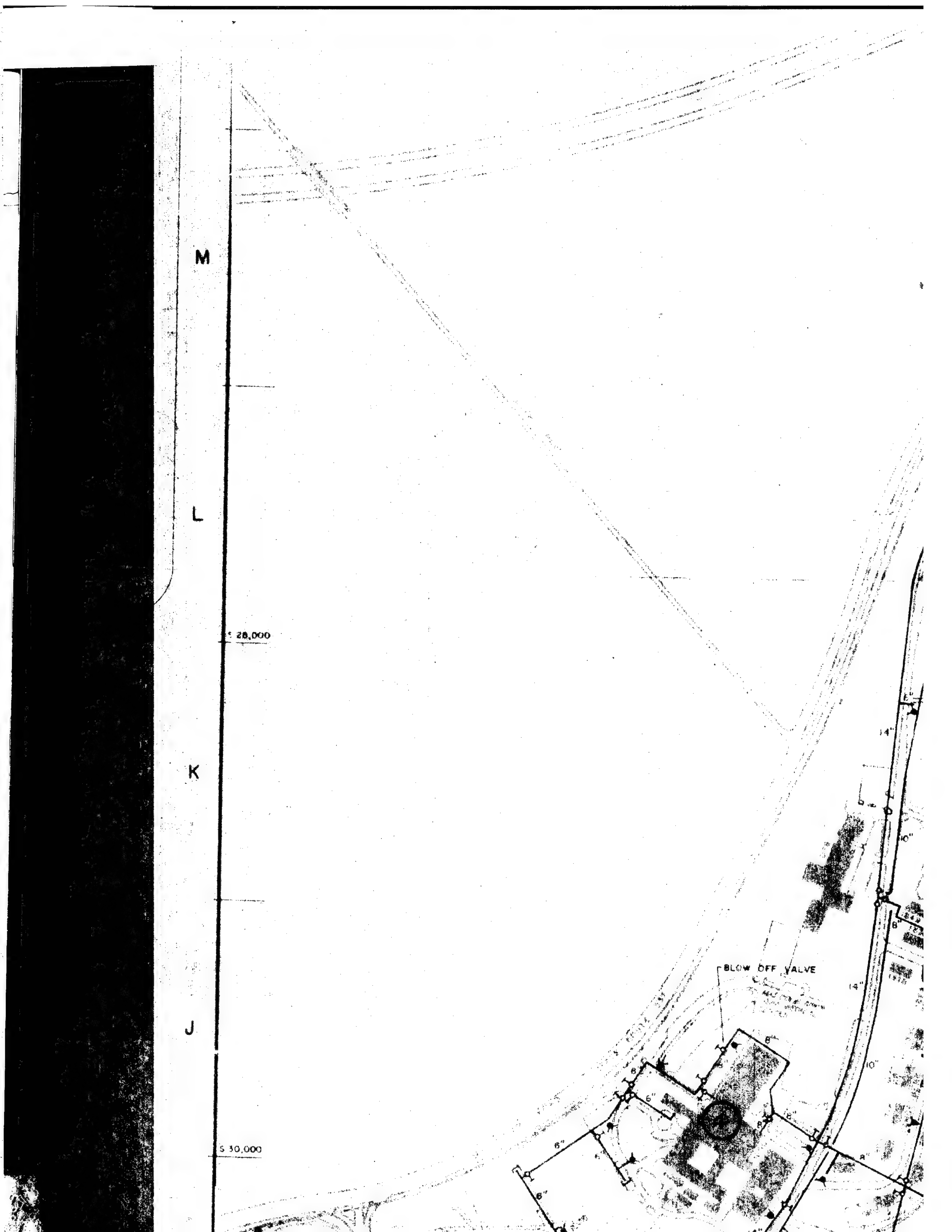

9
10
11
12
E 42,000
14"



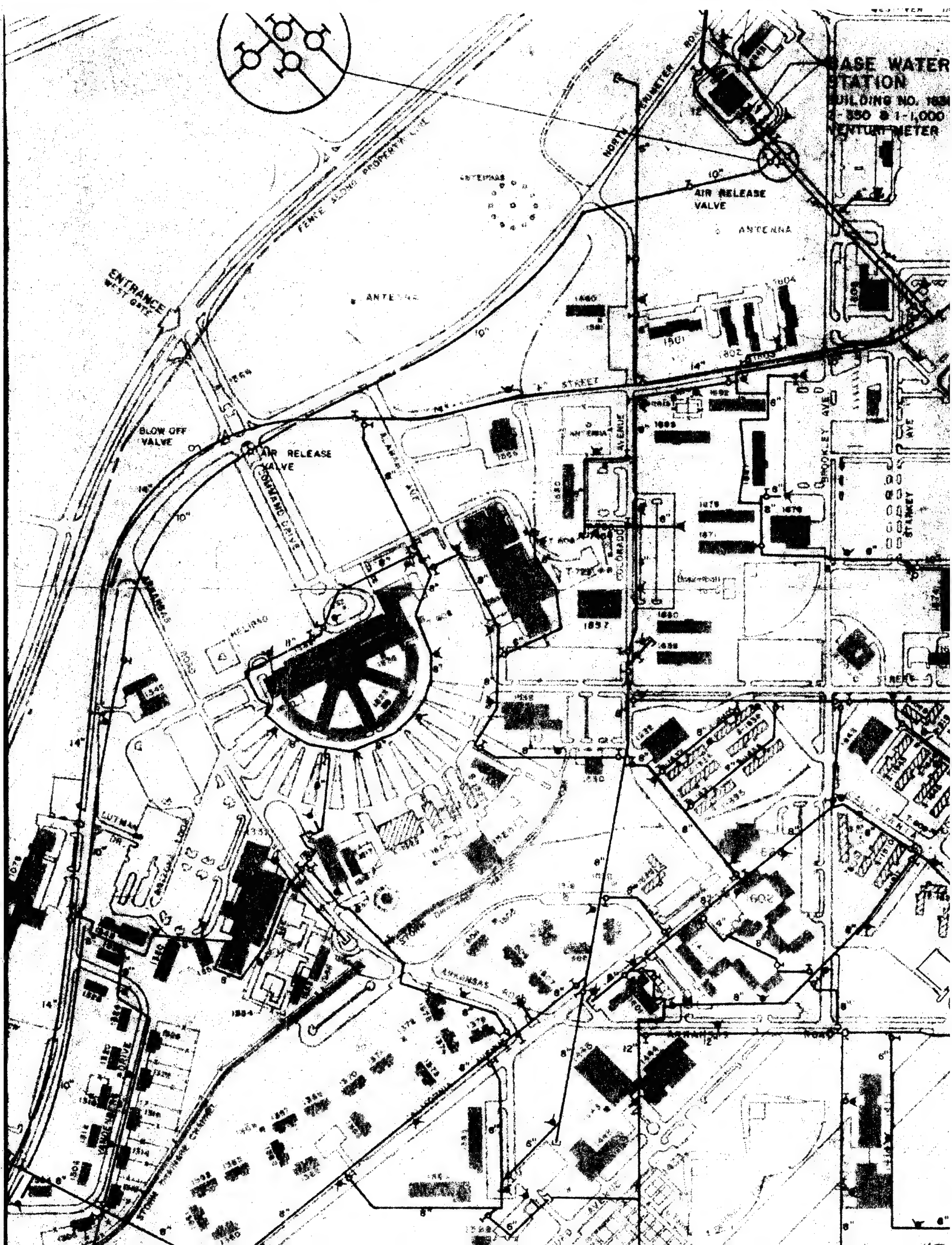
12
13
14
15
E 42,000
E 44,000
15
14
14" UNDER 8" MAIN
8"
6"

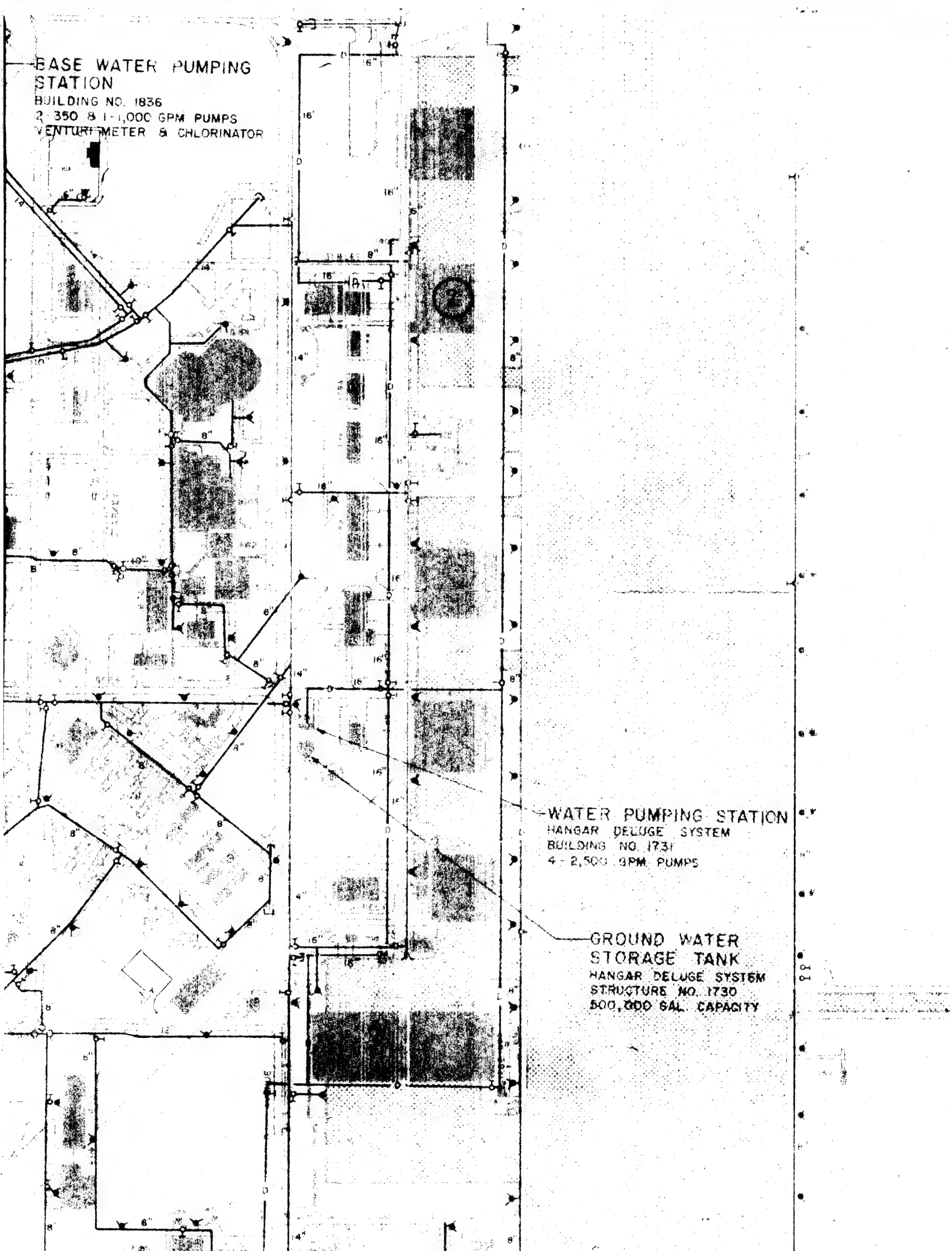


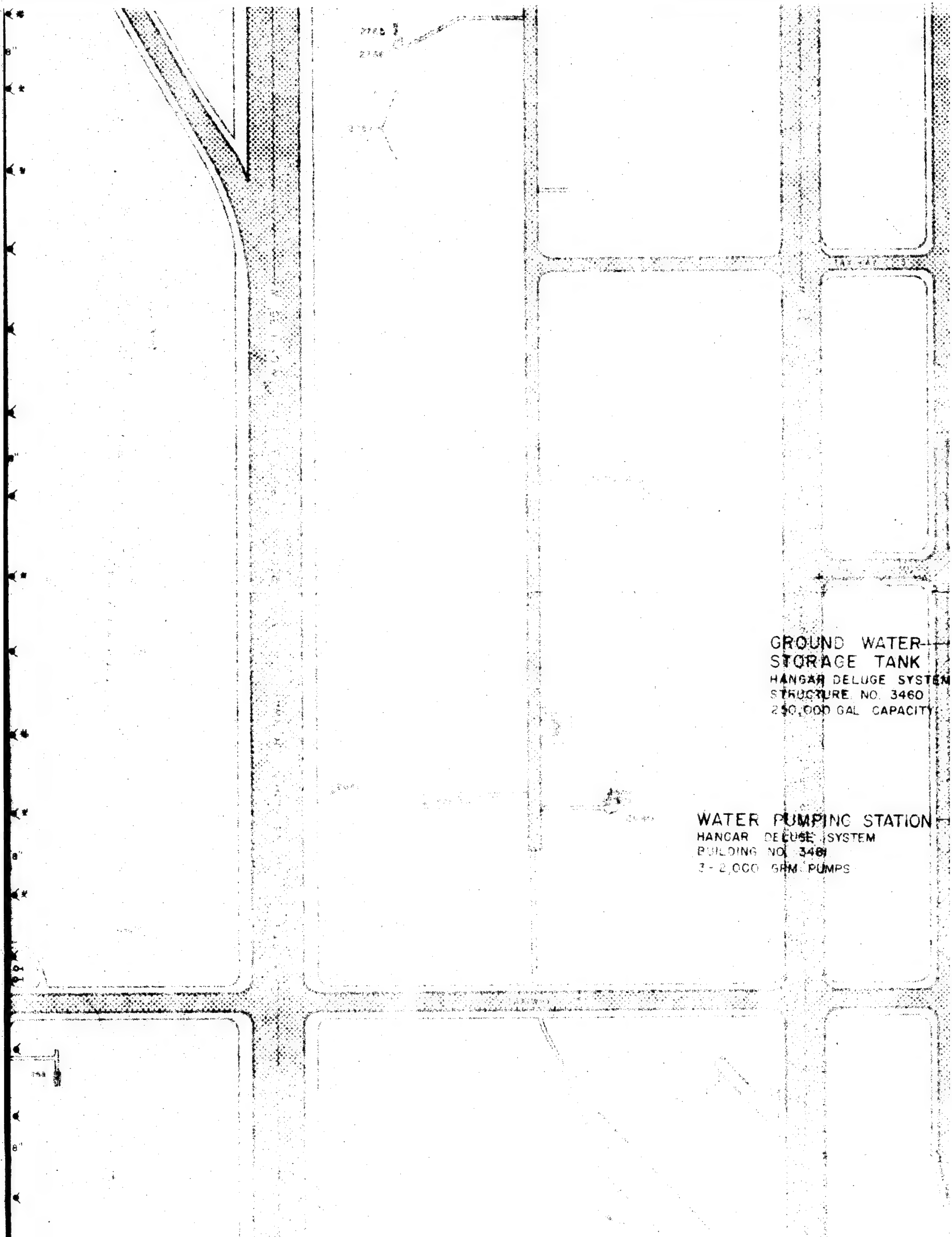
14
15
16
E 44,000
S 22,000
S 24,000
S 26,000
Q
P
O
N
8"
6"
2"
15
14

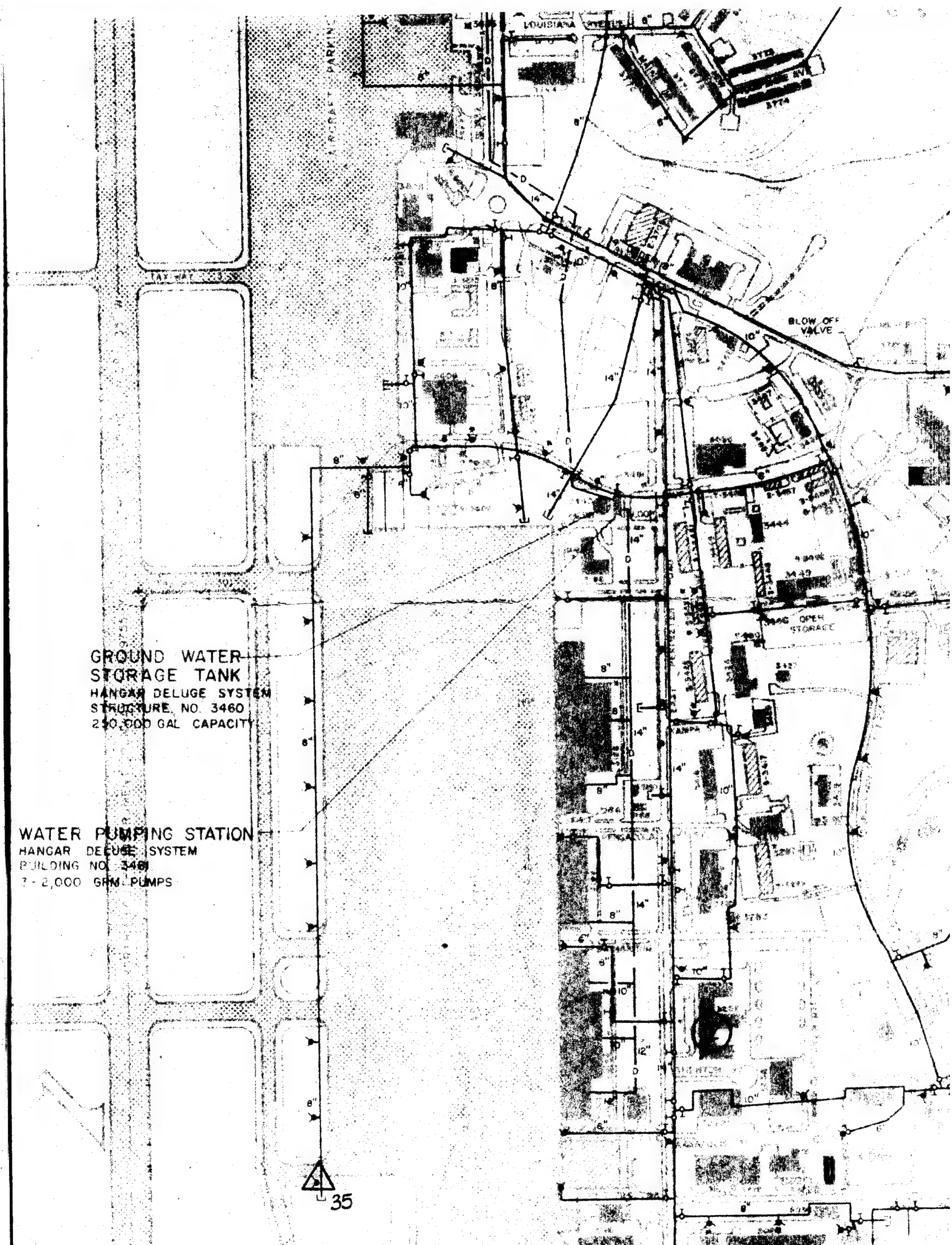


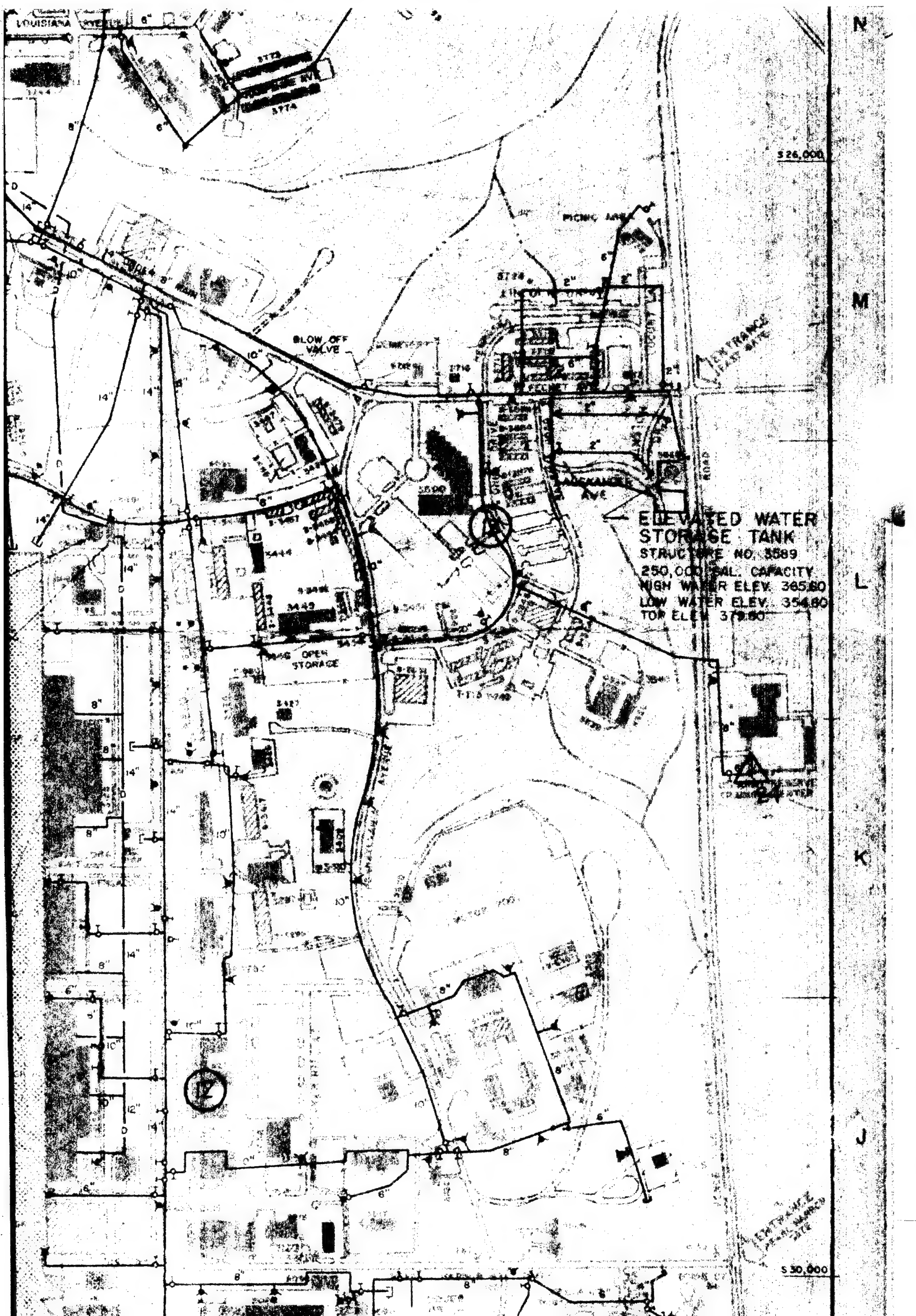
M
L
S 28,000
K
BLOW OFF VALVE
14"
10"
8"
6"
J
S 30,000


BASE WATER
STATION
BUILDING NO. 18
VENTURI METER
AIR RELEASE
VALVE
ANTENNA
ANTENNAS
ENTRANCE
WEST GATE
FENCE ALONG PROPERTY LINE
NORTH PERIMETER ROAD
BLOW OFF
VALVE
AIR RELEASE
VALVE
COLORADO AVENUE
BROOKLEY AVE
STINKEY
HELIPAD
LUTMAN DR.
ARKANSAS
STONE DRAINAGE CHANNEL

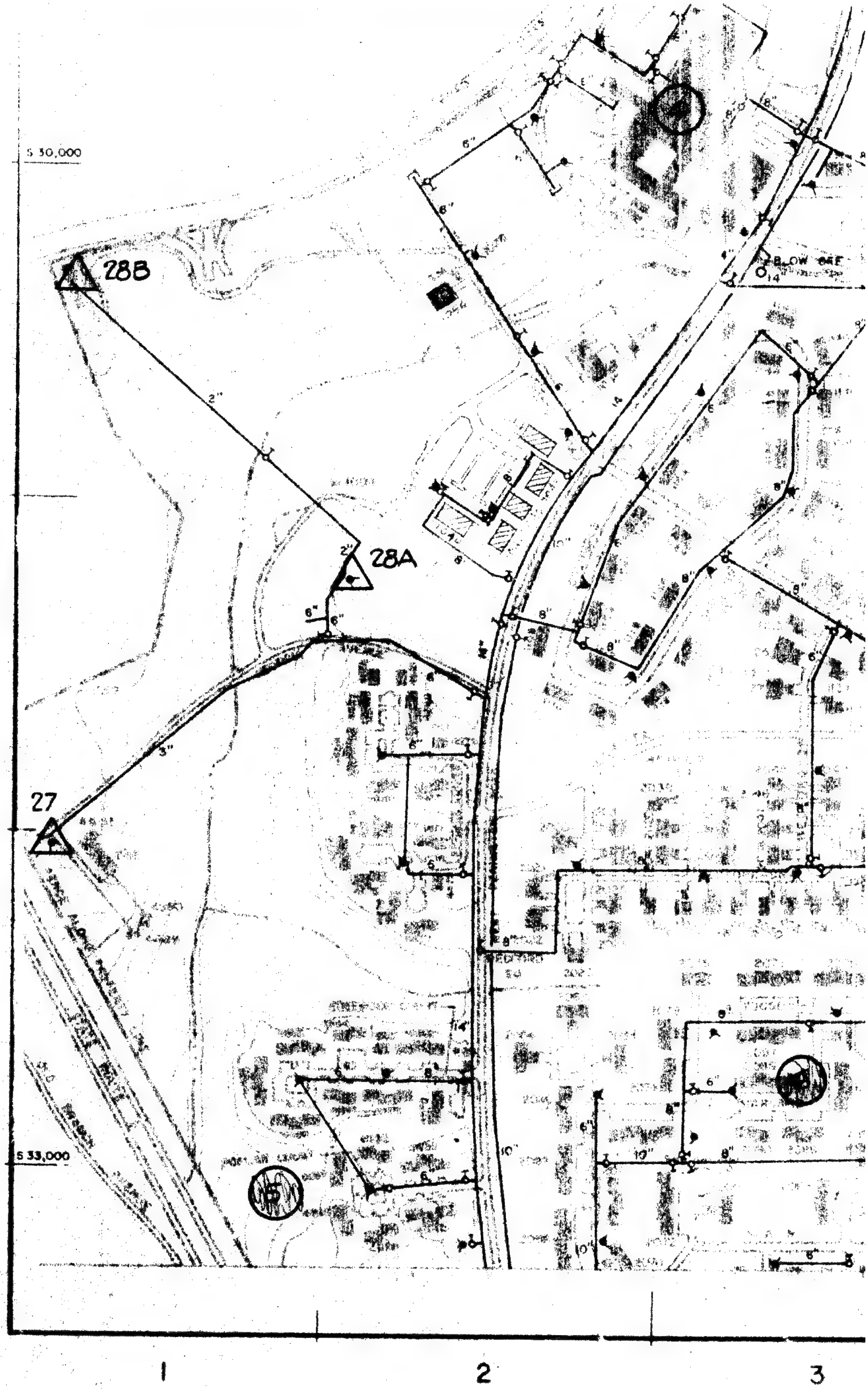

BASE WATER PUMPING STATION
BUILDING NO. 1836
2-350 & 1-1,000 GPM PUMPS
VENTURI METER & CHLORINATOR
WATER PUMPING STATION
HANGAR DELUGE SYSTEM
BUILDING NO. 1731
4-2,500 GPM PUMPS
GROUND WATER STORAGE TANK
HANGAR DELUGE SYSTEM
STRUCTURE NO. 1730
500,000 GAL. CAPACITY


GROUND WATER
STORAGE TANK
HANGAR DELUGE SYSTEM
STRUCTURE NO. 3460
250,000 GAL CAPACITY
WATER PUMPING STATION
HANGAR DELUGE SYSTEM
BUILDING NO. 3461
3 - 2,000 GPM PUMPS

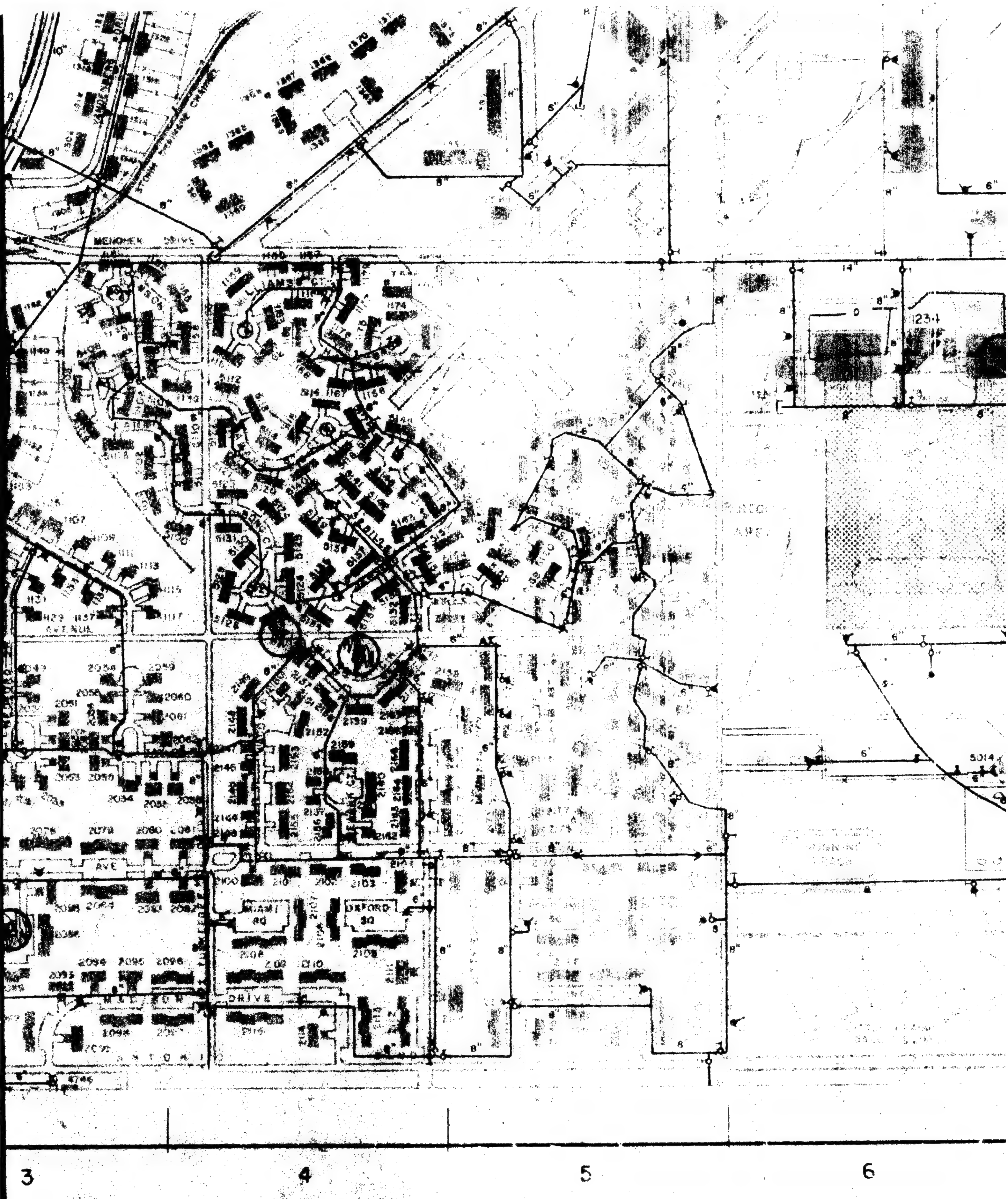

GROUND WATER STORAGE TANK
HANGAR DELUGE SYSTEM
STRUCTURE NO. 3460
250,000 GAL CAPACITY
WATER PUMPING STATION
HANGAR DELUGE SYSTEM
BUILDING NO. 3481
3 - 2,000 GPM PUMPS
BLOW OFF VALVE
LOUISIANA
OPEN STORAGE
35

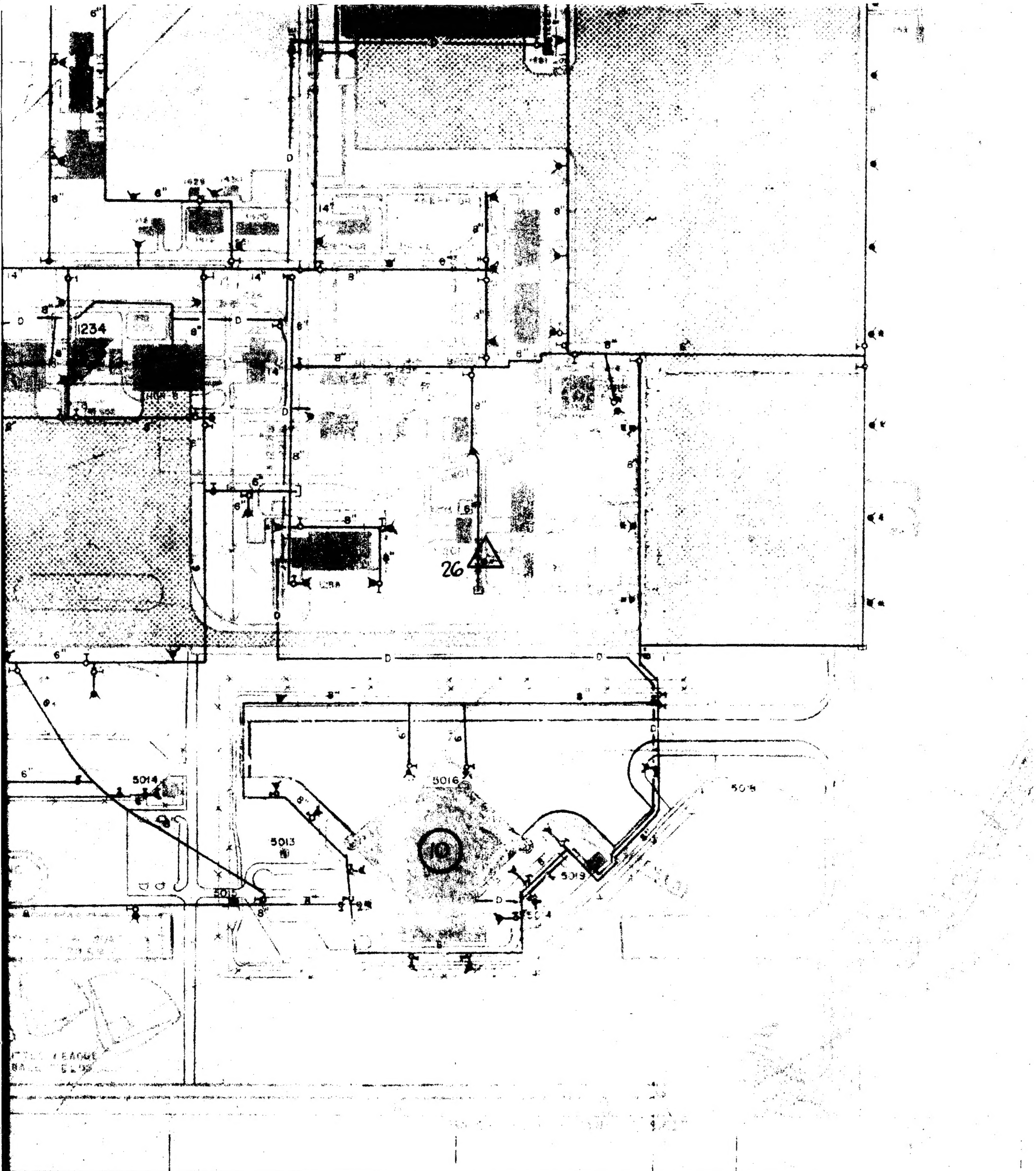


ELEVATED WATER
STORAGE TANK
STRUCTURE NO. 3589
250,000 GAL. CAPACITY
HIGH WATER ELEV. 365.80
LOW WATER ELEV. 354.80
TOP ELEV. 379.80
BLOW OFF
VALVE
OPEN
STORAGE
PICNIC AREA
LOUISIANA
N
M
L
K
J
S 26,000
S 30,000

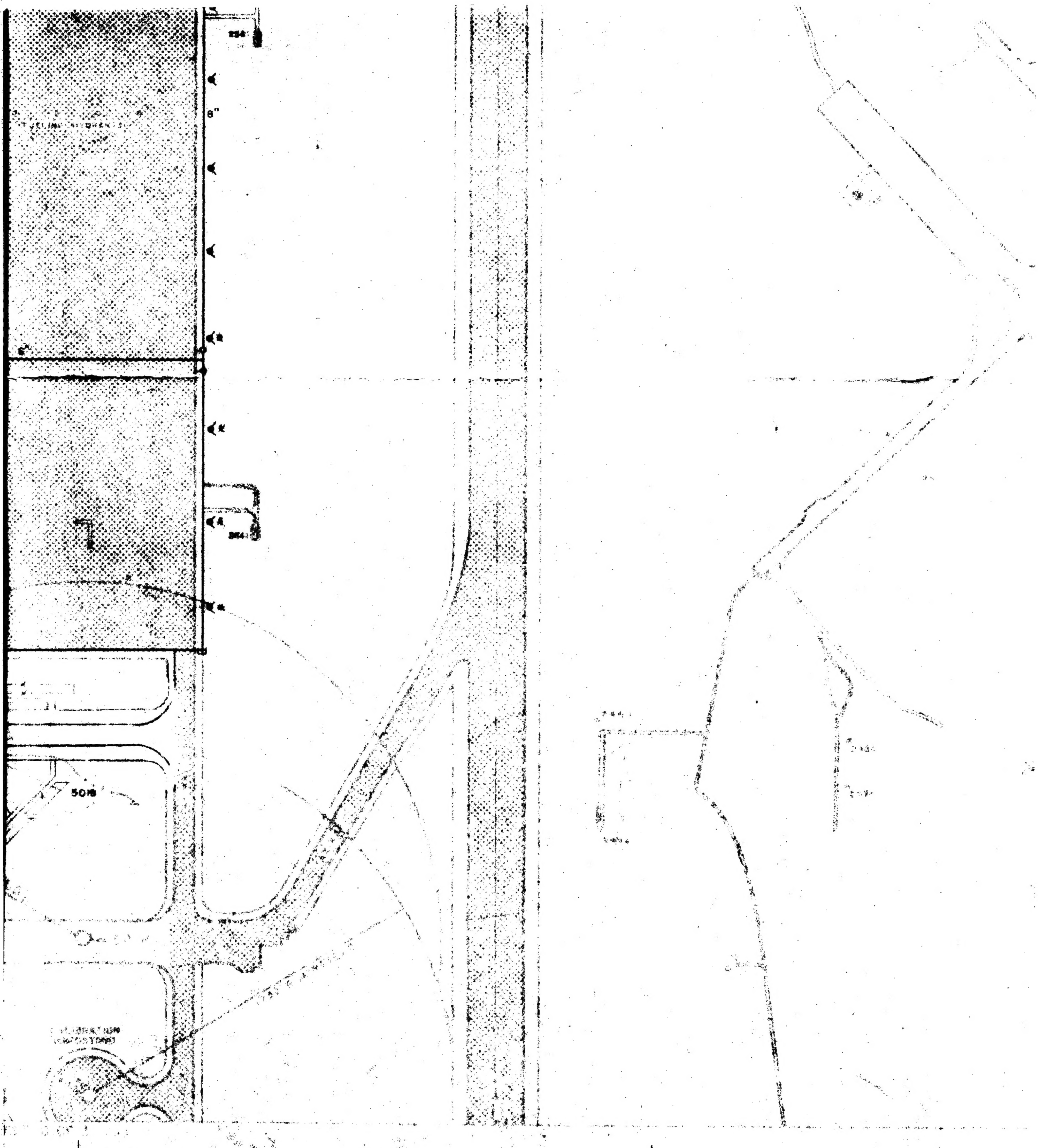


S 30,000
28B
28A
27
S 33,000
H
G
F
1
2
3

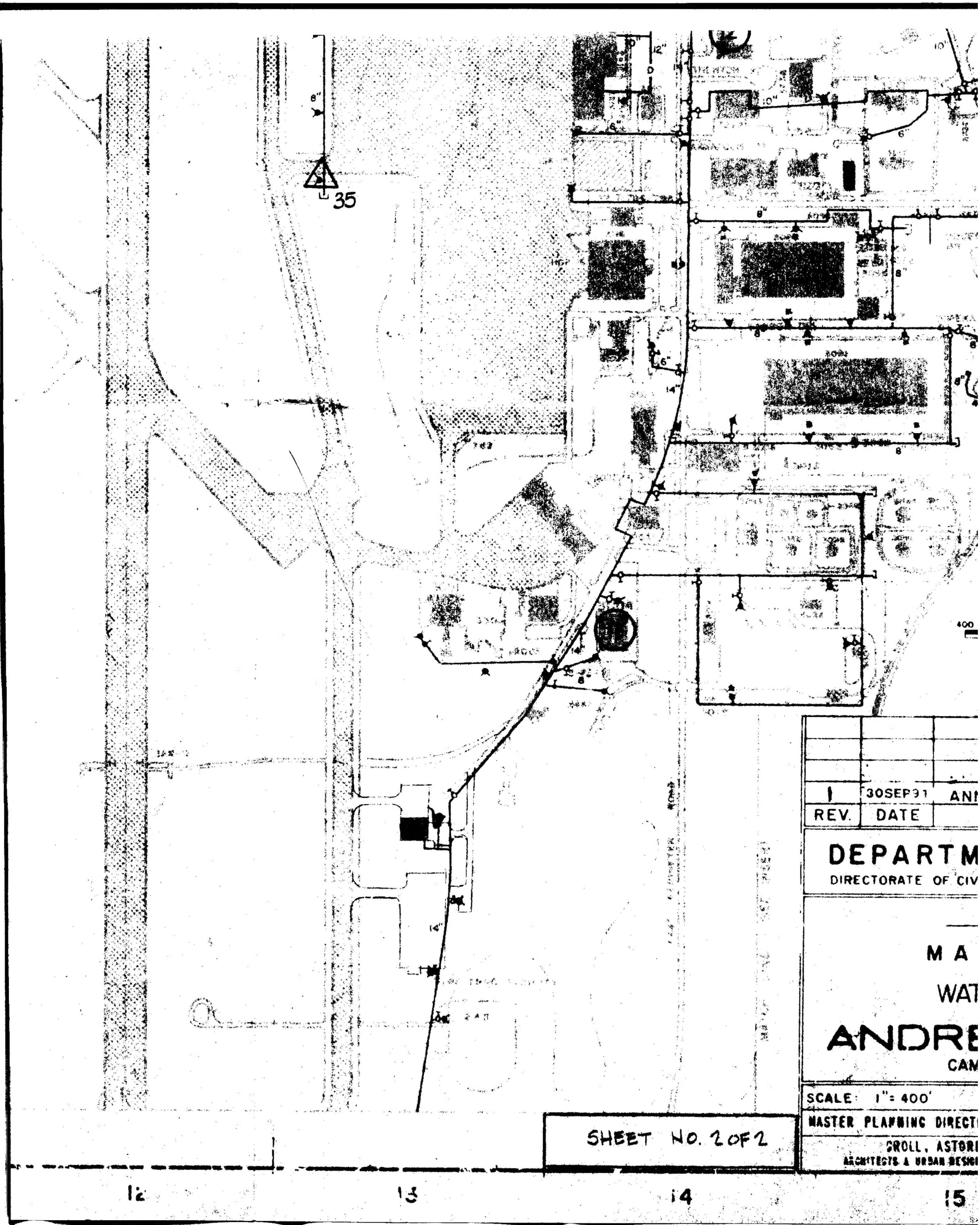

AVENUE
MIAMI
80
OXFORD
30
DRIVE
AVE
3
4
5
6



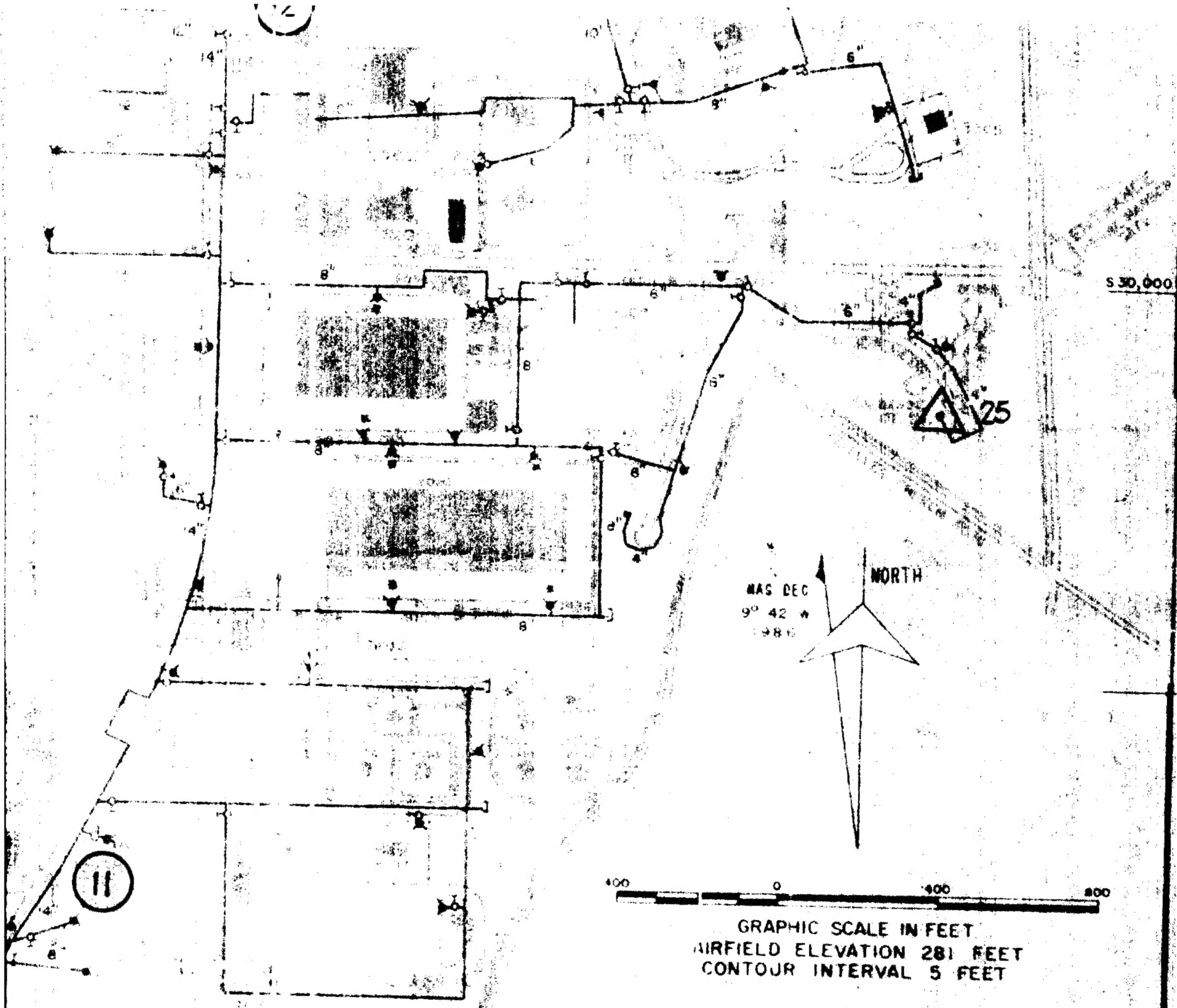
6 7 FOR OFFICIAL USE ONLY 9



ONLY 9 10 11



35
14"
8"
6"
1
30SEP91
ANI
REV.
DATE
DEPARTM
DIRECTORATE OF CIV
MA
WAT
ANDRE
CAM
SCALE: 1" = 400'
MASTER PLANNING DIRECT
CROLL, ASTOR
ARCHITECTS & URBAN DESIG
SHEET NO. 2 OF 2
12
13
14
15



REV.	DATE	DESCRIPTION	INITIAL
1	30SEP91	ANNUAL REVISION	REH

DEPARTMENT OF THE AIR FORCE

DIRECTORATE OF CIVIL ENGINEERING DCS/P&R - WASHINGTON, D.C.

MASTER PLAN

WATER SUPPLY SYSTEM

ANDREWS AIR FORCE BASE

CAMP SPRINGS, MARYLAND

SCALE: 1" = 400'

DATE: DECEMBER 1970

MASTER PLANNING DIRECTIVE: AND 81-0

GROLL, ASTORE & KOERNER, INC.
ARCHITECTS & URBAN DESIGNERS - SILVER SPRING, MARYLAND

SHEET 2 OF 2

SHEET NO. 2 OF 2

J I H G F

14 15 16